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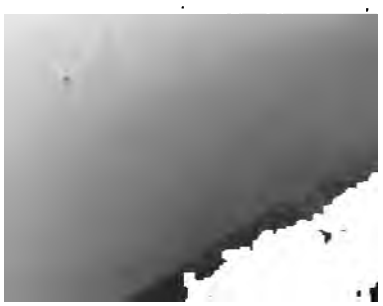

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TUMORS.

BY FREDERIC S. DENNIS, M. D.

THE word "tumor" has been used for many years in a most indiscriminate sense. Recently the attempt has been made to restrict the use of the term to a limited and peculiar kind of pathological growth. This change has been made possible by the increase of knowledge in histology and bacteriology, and also by advances in the science of embryology. At the present time the modern surgeon eliminates from the category of tumors many different varieties of neoplasms which were formerly considered in this class. Among the so-called neoplasms that have been thus eliminated may be mentioned all the infections, such as granuloma, tubercle, leprosy, gumma, glanders, actinomycosis, and cysts. It is evident, with these exclusions, that the word "tumor" is applied only to a select group of neoplasms.

A tumor has been defined as "a circumscribed new formation," but it contains no structural elements which are not found normally in the body. A tumor is the result of tissue-proliferation derived from one or more of the blastodermic layers of the fœtus. Lücke has defined a tumor as an "increase of volume by the production of new tissue without any corresponding physiological function." Hypertrophies are due to local changes in the nutrition of the tissue or organ, and have a tendency to become checked with a cessation of the action of the exciting cause. Tumors must not be embraced in the category of inflammatory new formations, which also have a tendency to become arrested and to disappear by resolution or by suppuration; and, finally, tumors must not be included in the category of cysts formed by extravasation of blood or by the development of fluid within a normal or obsolete duct; or, again, by the swellings caused by the displacement of some organ in the body. As a general rule, tumors are found in parts where in the fœtus the cell-growth is complicated, as the junction of the skin, labial glands, and mucous membrane, a typical illustration of which is seen in cancer of the lip.

Tumors are also found in places where there is great physiological activity, as the female breast, the testicle, the parotid gland, and the uterus, and in parts which are subjected to unusual mechanical irritation, as the lips, pylorus, ileo-cæcal valve, and rectum. Tumors are also frequently found to affect organs which are especially movable, as the tongue, breast, and uterus.

In 1838, Müller announced as a law that "the tissue of which a tumor is composed has its type in the tissues of the animal body, either in the adult or in the embryonic condition."

Virchow demonstrated that cells could not grow *de novo* in the economy except according to the laws which normally govern cell-growth in the body. He recognized in tumor-development homologous and heterologous growths; that is, if cells are found in places where they do not physiologically belong, as cartilage-cells in the parotid gland, the growth is heterologous. If epithelial cells are found in places in which they normally exist, as in epithelioma of the lip, the growth is said to be homologous.

Mitchell has pointed out the interesting clinical fact that "with a few exceptions the farther we proceed from the central organ (the heart) of the nutriment-distributing system, the more prone the organs and viscera appear to be to the formation of tumors." He cites as examples the great rarity of tumors primarily affecting the heart, the pericardium, and the lungs, and the frequency of tumors of the uterus, the mammary gland, and the testicles, to which may be added also the extremities.

A study of the etiology of malignant tumors—or, in fact, of benign tumors—is fraught with great interest. For many years the writer has given the closest clinical observation to an investigation into the causes which give rise to the development of malignant tumors. At the present time the weight of opinion seems to be opposed to the germ or parasitic origin of neoplasms. Clinical evidence seems to point strongly in favor of the view that changes of an inflammatory nature are responsible for the development of tumors in a large majority of the cases.

From a study of the etiology of tumors, as contained in the histories of the cases to be presently narrated, it becomes evident that mechanical injury is associated with sarcoma, notably of bone; that peripheral irritation is connected with carcinoma; and that sinus or other irritation is associated with epithelioma.

In the cases to be narrated in order to demonstrate the fact already mentioned in regard to the etiology of tumors, a few only of a large number have been selected. They have been taken from the note-book of the writer, who operated upon all the cases, and who possesses a written microscopical report of each tumor, as well as the history both at the time and since the operation. A study of the following concrete cases illustrates most forcibly the etiology of sarcoma from mechanical injury.

The first patient was thrown from the end of a platform of a freight-car, and was caught upon an iron upright, from which he was held suspended. An examination of the injured limb revealed the presence fracture of the lower end of the femur. Every precaution was the treatment of the fracture, but it failed to unite in the From the seat of the original injury in nine months from accident a subperiosteal sarcoma developed.

In another case the patient received an injury skating. In three months from the time of the sarcoma developed at the site of injury.

In still another case the patient swelling appeared at once. In three dent a central sarcoma grew from th

In another instance a school-tea his leg violently against a school-b

the seat of injury, and in less than three months a subperiosteal sarcoma developed at that point.

Again, a young girl was struck upon the tibia by a stone. A swelling appeared, and within six months a tumor developed from the injured point. As the diagnosis was doubtful, the patient was placed under the influence of ether and a portion of the suspected growth was removed, which was examined by Dr. Dunham while the patient was under the anæsthetic. The opinion was given that the tumor was sarcoma. The presumption of sarcoma was thus established as an indisputable fact, and the limb amputated then and there without further delay.

Still, again, a girl received a fall upon the back of the head while exercising upon roller-skates. She struck upon the occipital bone and a hæmatoma quickly developed. In six months following the accident a huge sarcoma developed at the place where the hæmatoma was situated, which caused total blindness and in a short time death. The autopsy showed a linear fracture of the occipital bone, at the site of which this sarcoma had developed.

In the last case a young lady struck the back of her hand while exercising in the gymnasium. Over the site of the injury a swelling immediately developed, and in a few months a sarcoma appeared. An interesting clinical fact in connection with this case, as well as in two other cases of sarcoma, was the simultaneous appearance of tubercular joint-abscess. In this connection it might be stated that the simultaneous appearance of carcinoma and tuberculosis seldom occurs, and also that sarcoma and carcinoma are rarely seen in the same patient.

These cases of sarcoma are narrated because they have all a clear and unmistakable history of direct injury to the bone. In each case the original swelling was the seat of the malignant tumor, and in all cases but one the sarcoma appeared within six months from the time of the receipt of the original injury. In each case a microscopical examination of the tumor was made by an experienced microscopist, and in each case the tumor has been preserved and the subsequent history known. The diagnosis was beyond doubt, and the history of injury was based upon reliable authority. The interesting question arises as to whether there is a direct relationship between the supposed cause and the effect. It is not so [illegible] the injury acted as a predisposing cause in the individual cases, but it is more difficult [illegible] disease when it appears simultaneously.

[illegible] tion whether there is a constitutional [illegible] lividual growth, or whether [illegible] re. Although the former [illegible] he acceptance of the latter [illegible] has seen sarcomata develop [illegible] days, beginning some nine [illegible] h no disseminated growths [illegible] thigh after amputation at [illegible] disease for nine months. [illegible] d rapidly disseminated, so [illegible] developed. There was no

return in the stump at the hip-joint, but in every organ in the body and in almost every individual bone sarcoma was present.

If a sarcoma will grow in forty-eight hours, is it not more than likely that from a local infection the multiple growths may derive their origin? Those cases of authentic history and of positive diagnosis reveal evidence of a very strong nature in favor of the inflammatory origin of sarcoma. The proof is not so conclusive in regard to carcinoma.

A study of the following concrete cases illustrates most forcibly the etiology of carcinoma from peripheral irritation:

A multipara gave birth to a living child during the seventh month of pregnancy. The child died and the mother's breasts were filled with milk. The glands, however, very soon ceased to secrete. Two months later a small piece of skin became loose upon the top of the nipple. This scale of skin separated and the surface underneath became irritated. A slight discharge followed, accompanied by a disagreeable itching sensation. This eczema continued for many months, and finally a lump appeared behind the eczematous nipple. The breast was amputated and the tumor was found to be epithelioma. The disease returned in the cicatrix, and for a period of three years no less than a dozen operations were performed. The disease was finally arrested in the breast and axilla, but a return occurred in the brain, from which the patient died eight years from the first appearance of the eczema of the nipple.

Another patient suffered from an ulcer in the mouth, which proved, upon microscopical examination, to be an epithelioma. The submaxillary and sublingual salivary glands were infected. The epithelioma with the glands were removed. The history revealed the interesting clinical fact that the patient had worn a red-rubber plate of false teeth for many months. The question naturally arises in connection with this case as in similar ones: Did the red-rubber plate cause the development of epithelioma? In an ordinary plate, which weighs about 288 grains, there are 96 grains of the sulphuret of mercury. This patient carried in the mouth daily 96 grains of the sulphuret of mercury, about 2 grains of which are in direct contact with the mucous membrane of the mouth; but such sulphuret of mercury is insoluble in water, though it may eventually be converted into a soluble salt by the constituents of the saliva. The increased action of the superficial vessels must produce an inflammation of the mucous membrane, which is irritated by the rubber plate. It is certain that the mercury in the red rubber is a source of irritation to the mucous membrane of the mouth, and for this reason alone either a gold or aluminum plate should be substituted. While the red rubber is not a cause of epithelioma, yet this material produces a long-continued irritation which devitalizes and deteriorates the tissues, and thus produces a soil favorable by malnutrition and by lowered vitality to the development of carcinoma. At all events, it is not apt to develop in the mouth of a patient who uses a gold plate. The question of mechanical friction must not be overlooked, though it is a notable fact that rarely if ever has an epithelioma been observed in a patient who wears a gold or aluminum plate.

Another patient was burned when a child, and a considerable amount of cicatricial tissue was formed upon the arm. At one point the scar was very tense, and finally an ulcer developed which proved to be epithelioma.

Malignant disease may also arise in the cicatrix of a gunshot wound under conditions similar to those just mentioned. These cases illustrate the law that in poorly-nourished tissues malignant disease is likely to occur, especially when there is present a continual source of irritation.

A farmer consulted the writer on account of an ulcer situated upon the inner side of the cheek. The ulcer was microscopically examined and proved to be epithelioma. The patient stated that for forty years he had carried a quid of tobacco in that spot. The irritating influences of the nicotine caused the tissues to be altered from their normal standard and made them ready to diverge from their normal mode of growth. Three other cases have occurred in which epithelioma developed under precisely these same conditions. Tobacco was not the cause *per se* of the epithelial cancer, but the irritation produced by the continual presence of nicotine predisposed the tissues by lowering their vitality. That these four cases of epithelioma started from the part of the buccal cavity in which tobacco is continually held is certainly a most significant fact. While a student in Langenbeck's clinic in Berlin the writer saw several other cases of epithelioma of the cheek, and to this disease the term "American disease" was applied because it was seen in that country, as a rule, only in those who chewed tobacco.

Another illustration of the law that continuous and unnatural irritation in the mouth is likely to cause epithelioma is found in the malignant growths affecting the tongue of those who nail laths. It is the custom of these mechanics to introduce into the mouth lath-nails and to push them out from the mouth with the tip of the tongue. An expert will take into his mouth and push out of it with the tip of the tongue, at a low estimate, several thousand nails per diem. This irritation continued day after day has been followed by carcinoma. Recently two cases of this kind have come under the writer's personal observation. It was not the contact of the tongue with the nails directly that caused the cancer, but the continued irritation lowered the vitality of the soft tissues, and thus predisposed them to the influences of malignant disease.

That the continued and unnatural irritation is likely to predispose the tissues to tumor-formation is seen in the irritation produced by soot in chimney-sweep's cancer; also in the irritation produced by a clay pipe, which by its adhesive qualities tears off from time to time the thin cuticle from the lip. Recently a case of epithelioma of the nose has come under the writer's notice, and the starting-point of the ulcer was over the site of the peripheral irritation produced by wearing eye-glasses with a tight spring.

The cases reported by Dr. Gerster of epithelioma of the rectum in patients who were in the habit of using the nozzle of an injection-syringe in such a manner as to daily bruise or lacerate the mucous membrane of the rectum is an illustration of the same law. Carious teeth with sharp edges afford a serious source of irritation, and with a predisposition in the patient to epithelioma might develop conditions favorable to the development of this tumor. The lacerated cervix is also another good example of irritation in poorly-nourished tissue resulting in epithelioma.

In sinus-irritation there is present a cause for the development of epithelioma. The writer observed a patient who had sustained a com-

pound fracture of the tibia, and from the superficial surface of the limb a small sinus led down to the necrosed bone. This sinus was lined with a pyogenic membrane and discharged thin, ichorous pus. After many months a typical epithelioma developed at the mouth of the sinus. The tumor was examined microscopically and found to be epithelioma. This case is a typical illustration of the law that a discharging sinus is a source of great danger to the patient, since the continual irritation induced by the acrid pus may lead to the development of true epithelioma. Such cases show the great danger of allowing a sinus either connected with necrosed bone or a diseased gland or a gunshot wound to remain without performing an operation for its radical cure.

In another case a gunshot wound of the shoulder-joint was followed by epithelioma. The wound nearly healed, leaving a small sinus which led down into the joint. This sinus remained open for many months, and at its mouth a typical epithelioma developed. The causes in this case which produced the epithelioma are identical with those just mentioned in the preceding case, and further serve to emphasize the dangers that attend a sinus which is left untreated by the surgeon.

The previously narrated cases of sarcoma in the writer's experience serve to forcibly illustrate the fact that sarcoma of bone is associated with injury, but every injury of bone is not followed by sarcoma. In like manner, the cases of carcinoma referred to serve to illustrate the clinical fact that carcinoma is associated with irritation; but it must be also borne in mind that in the great majority of cases of mechanical and chemical irritation neither sarcoma nor carcinoma develops, and hence some further explanation must be sought.

Epithelioma of the intestine in like manner is usually found in those places where there is a constriction, as the pyloric end of the stomach, ileo-cæcal valve, and the rectum—places where, in consequence of sudden alterations in calibre, the mechanical irritation will tell with greater effect. Finally, the cases of carcinoma which were developed from sinus-irritation point to the same etiological influence.

The theory of the parasitic origin of certain tumors has been brought into prominence of late. In accordance with this theory, the parasites, such as the dermodex in the skin and the coccidium in the intestine and the echinococcus in the liver, are mentioned as the exciting cause to develop tumors, but these conditions are not, strictly speaking, tumors, since they have been excluded.

In support of the parasitic origin of cancer it is maintained that the germs gain admittance into those glands which are in direct communication with the external atmosphere or through the medium of the intestinal gases. The mammary gland, the stomach, and the rectum are organs affected most frequently by cancer, and the entrance of the parasites is explained in the manner just described.

The frequency of epithelioma of the cervix as contrasted with the rarity of the disease affecting the uterus, the infrequency of epithelioma affecting the prostate as compared with the prepuce, the frequency of this disease affecting the lips as compared with the œsophagus, are among the illustrations in support of the parasitic origin of cancer.

The theory that fungi form carcinoma or sarcoma needs only a passing reference. There is no scientific proof that mycelium or spores cause

carcinoma or sarcoma. The presence of fungi in a few cases of malignant disease does not afford sufficient data upon which to base the opinion that fungi are the cause of carcinoma or sarcoma. This whole question must be left in abeyance, since as yet no satisfactory proof has been adduced to explain the etiology of malignant disease by fungi.

Among surgical writers there has been a tendency to disregard the influence of injury in the development of tumors, but the cases already narrated seem to point strongly to the view that sarcoma at least is the result of changes due to some kind of inflammation induced by injury, and that cancer in all probability is likewise the result of some peculiar inflammation produced by continual irritation. The clinical evidence is such that the surgeon cannot disregard the strong arguments in favor of the reversion to primary cells induced perhaps by inflammatory causes; and if this theory is accepted, the local origin of tumor seems evident. The general infection spreads from a local one, and the early and radical removal of the primary focus will prevent the widespread dissemination of malignant disease. The results which will be given in connection with special cases seem to point to the conclusion that malignant disease is at the outset the result of local injury or irritation, and the early and complete removal of the disease will effect a permanent cure.

From a clinical study of these cases of malignant tumors it becomes evident that certain facts are established. The first is, that, while injury or irritation may apparently give rise to malignant disease, in a greater number it only develops after a considerable interval, during which the vitality of the tissues has been lowered to such a state as to render them unstable. The second is, that all traumatisms of bone should be treated upon sound principles of surgery. These injuries should not be neglected as unworthy of consideration. The third is, that every unnatural irritation affecting integument or mucous membrane should be removed, for the reason that no one can foretell in what cases malignant diseases may or may not develop.

The vitality of the tissues of the individual is unstable, and the instability is in many cases transmitted hereditarily, which explains the existence of tumors in many members of the same family. In other words, it is the predisposition, for reasons just mentioned, and not the tumor itself, which is transmitted by heredity.

Heredity in the etiology of tumors must not be overlooked. By heredity, in this connection, is meant the transmission of certain tendencies to tumor-formation in the protoplasm. A careful investigation into the clinical history of malignant disease reveals the fact that from 12 to 15 per cent. of the cases can be traced to hereditary influences. There have been many interesting cases reported by various surgeons showing the influence of hereditary transmission of malignant disease.

The clinical history of tumor-formation as regards heredity is most forcibly impressed by a study of Broca's table, which has become of great historical interest:

First generation, Madame Z——, died of cancer of the breast in 1788, aged 60.
Second " four married daughters:
A, cancer of the liver, 62 years old, 1820.
B, " " " 43 " " 1805.
C, " " breast, 51 " " 1814.
D, " " " 54 " " 1827.

Third generation, Madame B——, five daughters and two sons:
First son died during infancy.
Second " of cancer of the stomach, 64 years old.
First daughter died " " breast, 35 " "
Second " " " " " } 35 to 40 years old.
Third " " " " " }
Fourth " " " " " }
Fifth " escaped the disease.
Madame C—— had five daughters and two sons:
The sons remained free from cancer.
The first daughter died of cancer of the breast in 1837, 37 years old.
Of her five children, one daughter died in 1854 of cancer of the breast, at the age of 49 years.
The second daughter died in 1822, 40 years old, of cancer of the breast.
The third daughter died in 1837, 47 years old, of cancer of the uterus.
The fourth daughter died in 1848, 55 years old, of cancer of the breast.
The fifth daughter died in 1856, 61 years old, of cancer of the liver.

It is recorded in the case of Napoleon I. that hereditary influence in the development of malignant disease was marked, since his father, a brother, and two of his sisters died of cancer of the stomach, a disease to which the emperor himself succumbed.

Finally, taking a given number of cases of tissue-irritation, in only a very small minority does a tumor develop at all, and in a much smaller minority does it develop immediately. Couple this with the fact that in a large proportion of cases of new growths there is no history of injury; consequently, while the theory is accepted that local irritation may be the actual or exciting cause, it follows that a more remote or predisposing cause must be sought in many cases to explain the incident of tumor-formation.

A dismissal of this part of the subject cannot be made without an allusion to Cohnheim's theory as to the causes of tumors. He asserts that tumors take their origin from embryonic cells which are in excess of the requirements of fœtal development, or from cells that are found in places or parts or organs where they do not normally belong. The cells remain dormant until an exciting cause is present to produce proliferation. He cites as an illustration that exostoses are developed from epiphyseal cartilage in the articular extremities of bones, and that the cartilage has not become converted into true bone as in the other parts of the osseous shaft, and that moles, which are formed of connective tissue, are often found to degenerate into sarcoma or epithelioma.

GROWTH OF TUMORS.—A tumor has a constant tendency to develop. The spontaneous disappearance of tumors, of which mention will be presently made, is exceptional, and by some pathologists it is considered impossible. As the tumor enlarges the pressure-effects give rise to ulceration, but sometimes, instead of the pressure producing sloughs upon the superficial tissues, it causes a retrograde change, so that calcareous salts are found deposited in the mass. This is especially apt to occur in fatty and cartilaginous tumors, the latter of which may also undergo mucoid softening or else give rise to cysts the interior of which are filled with a tenacious fluid derived from a liquefaction of the matrix, or else blood which causes sudden enlargement of the growth. Fatty degeneration may also occur especially in carcinoma, and sometimes in sarcoma, but rarely in innocent growths.

Inflammatory changes also occur during the course of the develop-

ment of tumors, and the appearance of pus, if not from tension- and pressure-effects, often affords a favorable prognosis. If the pus is present as result of tension, it denotes rapid growth of the tumor, and consequently malignancy. The writer has seen in one case a malignant disease in the mouth disappear after an incomplete operation for its removal. The wound was situated so that the streptococci and the staphylococci were retained in great abundance, and the wound discharged for many months. At the present time there is no evidence of the disease, and the wound has healed. Whether this is a case analogous to those cured by the toxines of erysipelas is an open question. At all events, the malignant tumor was there, as established by microscopical examination; the growth was not entirely removed by the operation, and after many months of suppuration the disease has disappeared and no trace of it can be found.

Classification of Tumors.—Tumors are divided clinically into benign and malignant. The *benign* tumor has usually circumscribed limits and is surrounded by a capsule. It grows very slowly, and shows no tendency to produce ulceration except by its mechanical pressure, or to return after it has been removed by the knife. The benign tumor is usually painless and free from cachexia. The *malignant* tumor has widespread infiltration by means of blood-vessels or lymph-channels and nodes. It grows, as a rule, very rapidly, and shows an early tendency to ulceration and to return after removal by the knife. The malignant tumor is usually painful, and cachexia is present sooner or later in every case. The degree of cachexia depends upon the presence and extent of ulceration and the absorption of the toxic products of the tumor.

The apparently simultaneous appearance of the growth in distant organs is indicative of malignancy. Dissemination may occur in almost any viscus of the body, as well as in any of the bones, muscles, or any part of the nervous system. The round-celled sarcoma and the carcinoma have the greatest tendency to metastasis, while cartilaginous tumors show no such tendency. Instead of metastasis as an indication of great malignancy, local recurrence may represent the tendency of the tumor toward malignancy. The neoplasmata which are most prone to local recurrence in place of metastasis are the recurrent fibroids of Paget, rodent ulcers, and epithelioma.

Malignant tumors may give rise to local, to regional, and to general infection. In local infection the tumor extends from its primary focus to the connective tissue in and about the tumor itself. The cells thus originate new tumors, and the entire mass eventually emerges into one growth. In regional infection the cells are carried from the primary focus by the lymphatics to neighboring nodes, and in every case the metastatic deposit is identical with the original growth. Upon serous surfaces, as the peritoneum and the pleura, the cells are carried along until the entire membrane is studded with malignant nodules.

In general infection the cells are transported to distant organs, and the disease remains no longer local, but becomes general and beyond the help of the surgeon.

General infection may be caused by the transportation of the cells through the lymphatics and blood-vessels. Carcinoma is less likely to give rise to general infection than sarcoma, and the latter also gives rise

to dissemination at an earlier period than carcinoma. Among the different varieties of sarcoma dissemination occurs more frequently in the small- than the large-cell variety.

A line of demarcation is thus drawn between benign and malignant tumors. It must, however, always be borne in mind that the former under favorable circumstances may assume the characteristics of the latter. It is therefore a risk to leave any tumor in the body, since the most simple can become the most malignant. A benign tumor can cause death by pressure-effects; thus an ordinary lipoma may press upon the thoracic duct and produce starvation. A benign tumor, again, can cause death by ulceration into a vessel and set up secondary hemorrhage, or the simple tumor may set up an abscess and blood-poisoning result. A benign tumor may also assume a malignant type by departing from its simple type and becoming mixed with other varieties; for example, a lipoma, if simple, is innocent; if mixed with a connective-tissue tumor like sarcoma, the resulting product is no longer innocent, but soon becomes malignant.

A marked distinction exists between tumors on the one hand and inflammatory neoplasms on the other, in that the former have a tendency to grow continuously, while the latter have a tendency to come "to a typical end." An inflammatory neoplasm can be produced at will, while a tumor cannot be so developed. A classification based upon clinical features is not one which can be utilized with advantage.

Onconymy and Oncotaxy.

The following nomenclature and classification of tumors, based mainly upon their origin and structural characters, prepared by Dr. J. W. S. Gouley, is published in advance by his permission. The tables are tentative and subject to modification. The structural basis is adhered to as consistently as practicable, all departments of anatomy being made subservient to the purposes of naming and systematically grouping these morbid growths. Any single department would be insufficient to constitute the basis, whilst all jointly give a stable and solid foundation. Thus descriptive anatomy, physiology, embryology, the law of Müller, the blastodermic theory, morphism, and even ætism, are all laid under contribution as occasion requires.

To serve as a syllabus for their special study, those anomalies recognized by pathologists as tumors may be classed as follows:

Class I. Neoplasmata (*new-growths*).
Class II. Cystomata[1] (*cystic tumors*).
Class III. Teratomata[1] (*teratic tumors*).

The class neoplasmata, comprising tumors developed largely from cell-proliferation, contains the following orders:

Order I. Epithelial Neoplasmata (*epithelial new-growths*).
Order II. Adenoid Neoplasmata (*adenoid new-growths*).

[1] Tables of the cystomata and teratomata, now in course of preparation, are too incomplete for publication.

ORDER III. ENDOTHELIAL NEOPLASMATA (*endothelial-cell new-growths*).
ORDER IV. CHONDRO-NEOPLASMATA (*cartilage new-growths*).
ORDER V. OSTEO-NEOPLASMATA (*bone new-growths*).
ORDER VI. ODONTO-NEOPLASMATA (*tooth new-growths*).
ORDER VII. MYO-NEOPLASMATA (*muscle-tissue new-growths*).
ORDER VIII. NEURO-NEOPLASMATA (*nerve-tissue new-growths*).
ORDER IX. ANGEIO-NEOPLASMATA (*vessels new-growths*).

The next table exhibits the relations of the various members of the order epithelial neoplasmata down to the subvarieties:

CLASS I. NEOPLASMATA.

ORDER I. EPITHELIAL NEOPLASMATA.

GENUS I. EPITHELIOMA.

Species 1. Polymorpho-cellular epithelioma (*cancer*).
VARIETY 1. Polymorpho-cellular ino-epithelioma (*medullary cancer*).
VARIETY 2. Polymorpho-cellular hyperino-epithelioma (*scirrhous cancer*).
Subvariety 1. Teleangeiectatic polymorpho-cellular ino-epithelioma (*fungus hæmatodes*).
Species 2. Cylindro-cellular epithelioma (*cylindroma*).
VARIETY 1. Cylindro-cellular ino-epithelioma.
Subvariety 1. Papillary cylindro-cellular ino-epithelioma.
Subvariety 2. Teleangeiectatic cylindro-cellular ino-epithelioma.
Species 3. Squamo-cellular epithelioma (*epithelioma, cancroid*).
VARIETY 1. Myxoid squamo-cellular epithelioma.
VARIETY 2. Keratoid squamo-cellular epithelioma.
Subvariety 1. Papillary squamo-cellular epithelioma.

Of the order epithelial neoplasmata, epithelioma is the only genus, and this genus has three species.

The names given to the order and genus indicate that they comprise all epithelial new-growths.

The name given to Species 1 indicates that the tumor is chiefly composed of cells of many forms, constituting one of the essential characteristics of what is commonly called cancer.

Variety 1, of Species 1, bears the name of the species, with the affixion of *ino*, to indicate that it contains fibrous tissue—the fibrous tissue forming alveoli, with thin walls, in which the cells are enclosed. This is one of the essential characteristics of what is known as medullary cancer.

Variety 2, of Species 1, bears the name of the species, with the affixion of *hyperino*, to indicate that it has an excess of fibrous tissue—the excess of fibrous tissue forming thick-walled alveoli, in which the cells are enclosed. This is the essential characteristic of what is known as scirrhous cancer.

Subvariety 1, of Variety 1, bears the name of the variety, with the affixion of *teleangeiectatic*, to indicate that the tumor contains dilated

blood-vessels. This is the main characteristic of what has been called fungus hæmatodes.

The polymorphism of the cells of this species of epithelioma, and the presence of fibrous tissue in its varieties, show it to be derived from the elements of the epiblast, hypoblast, and mesoblast.

Species 2 is named to indicate that the tumor is chiefly composed of cylindrical epithelial cells.

Variety 1, of Species 2, bears the name of the species, with the affixion of *ino*, to indicate that it contains fibrous tissue.

Subvariety 1, of Variety 1, bears the name of the variety, with the affixion of *papillary*, to indicate that its surface is covered with papillary projections.

Subvariety 2, of Variety 1, bears the name of the variety, with the affixion of *teleangeiectatic*, to indicate that it contains dilated blood-vessels.

The form of the cells of this species of epithelioma shows that it is derived from the elements of the hypoblast.

Species 3 is named to indicate that the tumor is chiefly composed of squamous epithelial cells. This is the essential characteristic of what is commonly called epithelioma.

Variety 1, of Species 3, bears the name of the species, with the affixion of *myxoid*, to indicate that its cells are like those of the mucous layer of the epidermis.

Variety 2, of Species 3, bears the name of the species, with the affixion of *keratoid*, to indicate that its cells are like those of the external layer of the epidermis, and show a tendency to horny formation.

Subvariety 1 is named to indicate the existence of papillary projections from the surface of the growth.

The form of the cells of this third species of epithelioma shows that it is derived from the elements of the epiblast.

Colloid and melanotic are not included among the subvarieties, any more than other degenerations and infiltrations, on account of the fact that not only the tumors, but other diseased tissues of the body, are liable to colloid and fatty degeneration and to pigmentary and calcareous infiltration.

The tumor called atrophying (shrivelling) scirrhous cancer is also excluded from this classification, for the reason that the condition in question is not essential to any species, variety, or subvariety. It is simply an incidental retrograde metamorphosis, a sclerous degeneration of the fibrous tissue of a polymorpho-cellular hyperino-epithelioma.

The adenoid neoplasmata are gland-like new growths, with an imperfectly elaborated and generally sterile structure. They are characterized by epithelial hyperplasia, and tend to metamorphosis into malignant epitheliomata, which occurs when the cell-proliferation is so rapid and excessive as to break the barrier opposed to these epithelia by the limiting membrane of the acini and tubes. Sometimes, instead of excessive epithelial proliferation and consequent epitheliomatous transformation, there is endothelial hyperplasia and endotheliomatous transformation, the cells sometimes retaining their embryonal character and constituting malignity, but often progressing into fibrous tissue and inomatous trans-

formation with the characters of benignity. It is more than likely that many malignant epitheliomata and endotheliomata begin as diffuse and also as circumscribed adenoid neoplasmata, arising in the internal as well as in the external glands. These adenoid neoplasmata form the second order of the class neoplasmata, comprising one genus and two sub-genera.

ORDER II. ADENOID NEOPLASMATA.

GENUS I. ADENOMA.

Sub-genus I. Diffuse Adenoma.

Species 1. Squamo-cellular diffuse adenoma.
Species 2. Cubico-cellular diffuse adenoma.
Species 3. Cylindro-cellular diffuse adenoma.
VARIETY 1. Squamo-, cubico-, or cylindro-cellular diffuse endothelio-adenoma.
VARIETY 2. Squamo-, cubico-, or cylindro-cellular diffuse ino-adenoma.
Subvariety 1. Teleangeiectatic squamo-, cubico-, or cylindro-cellular diffuse adenoma.
Subvariety 2. Papillary squamo-, cubico-, or cylindro-cellular diffuse adenoma.

Sub-genus II. Circumscribed Adenoma.

Species 1. Squamo-cellular circumscribed adenoma.
Species 2. Cubico-cellular circumscribed adenoma.
Species 3. Cylindro-cellular circumscribed adenoma.
VARIETY 1. Squamo-, cubico-, or cylindro-cellular circumscribed endothelio-adenoma.
VARIETY 2. Squamo-, cubico-, or cylindro-cellular circumscribed ino-adenoma.
Subvariety 1. Teleangeiectatic squamo-, cubico-, or cylindro-cellular circumscribed adenoma.
Subvariety 2. Papillary squamo-, cubico-, or cylindro-cellular circumscribed adenoma.

The endothelial neoplasmata, sometimes called desmo-neoplasmata, the elements of some of them being embryonic states of different forms of connective tissue, constitute the third order of the class neoplasmata, which embraces the following genera:

GENUS I. NEUROGLIOMA[1] (*nerve-glue tumor*).
GENUS II. MYXOMA (*mucous-tissue tumor*).
GENUS III. ENDOTHELIOMA[2] (*endothelial-cell tumor, endothelial cancer, sarcoma*).
GENUS IV. INOMA[3] (*fibroma, fibrous tumor*).

[1] The term "neuroglioma" is intended to convey the idea of a tumor formed of neuroglia, and seems more appropriate than glioma, which means glue-tumor, whereas neuroglioma signifies nerve-glue tumor.
[2] Endothelioma, as opposed to epithelioma, is certainly better than sarcoma, which denotes nothing more than a fleshy tumor.
[3] Inoma, from ἴς, ἰνος, fibre, suggested long ago by Sir James Paget, is surely more accurate than Dr. Verneuil's hybrid word "fibroma."

The subjoined table exhibits the relationship of the several members of the order endothelial neoplasmata down to the subvarieties. An endeavor is made, in this and other tables, to employ terms likely to convey a correct idea of the composition and nature of the several genera, species, varieties, and subvarieties of new-growths:

ORDER III. ENDOTHELIAL NEOPLASMATA.

GENUS I. NEUROGLIOMA.

Species 1. Neuroglioma.
VARIETY 1. Endothelio-neuroglioma.

GENUS II. MYXOMA.

Species 1. Monomorpho-cellular myxoma.
Species 2. Polymorpho-cellular myxoma.
VARIETY 1. Endothelio-myxoma (*sarco-myxoma*).
VARIETY 2. Ino-myxoma (*fibro-myxoma*).
VARIETY 3. Lipo-myxoma.
Subvariety 1. Teleangeiectatic endothelio-, ino-, or lipo-myxoma.
Subvariety 2. Papillary endothelio-, ino-, or lipo-myxoma.

GENUS III. ENDOTHELIOMA (*Sarcoma*[1]).

Species 1. Globo-cellular endothelioma (*small and large-celled*).
VARIETY 1. Globo-cellular myxo-endothelioma (*myxo-sarcoma*).
VARIETY 2. " lympho-endothelioma (*lympho-sarcoma*).
VARIETY 3. " ino-endothelioma (*fibro-sarcoma*).
VARIETY 4. " alveolar endothelioma (*alveolar sarcoma*).
Subvariety 1. Globo-cellular teleangeiectatic endothelioma (*fungus hæmatodes*).
Subvariety 2. Globo-cellular papillary endothelioma (*papillary sarcoma*).
Species 2. Fuso-cellular endothelioma (*small and large-celled*).
VARIETY 1. Fuso-cellular ino-endothelioma (*fibro-sarcoma*).
VARIETY 2. " alveolar endothelioma (*alveolar sarcoma*).
VARIETY 3. " chondro-endothelioma (*chondro-sarcoma*).
VARIETY 4. " osteo-endothelioma (*osteo-sarcoma*).
VARIETY 5. " rhabdomyo-endothelioma (*rhabdo-myoma*).
Subvariety 1. Fuso-cellular teleangeiectatic endothelioma (*fungus hæmatodes*).
Subvariety 2. Fuso-cellular papillary endothelioma (*papillary sarcoma*).
Species 3. Plano-cellular endothelioma (*flat-celled sarcoma, endothelioma*).
VARIETY 1. Plano-cellular ino-endothelioma (*flat-celled fibro-sarcoma*).
Subvariety 1. Plano-cellular psammo-ino-endothelioma (*psammoma*).
Subvariety 2. Plano-cellular papillary psammo-ino-endothelioma (*papillary psammoma*).

[1] The so-called giant-celled sarcoma is not included in this classification, because giant cells do not form specific growths, but occur more or less in different tumors.

GENUS IV. INOMA (*Fibroma, Fibrous Tumor*).

Sub-genus I. Circumscribed Inoma.

Species 1. Plano-cellular circumscribed inoma.
Species 2. Fasciculated circumscribed inoma.
VARIETY 1. . . . . endothelio-inoma (*sarco-fibroma*).
VARIETY 2. . . . . myxo-inoma (*myxo-fibroma*).
VARIETY 3. . . . . lipo-inoma[1] (*lipoma, fatty tumor*).
Subvariety 1. . . . . . teleangeiectatic . . . inoma.
Subvariety 2. . . . . . papillary . . . inoma (*wart*).

Sub-genus II. Diffuse Inoma.

Species 1. Plano-cellular diffuse inoma.
Species 2. Fasciculated diffuse inoma.

The varieties of these species are exemplified in molluscum fibrosum and in diffuse lipo-inoma.

The chondro-neoplasmata are cartilage new-growths, which arise not only in or near normal cartilage, but among structures in whose substance no cartilage exists in health. These cartilage tumors constitute the fourth order of neoplasmata, with one genus:

ORDER IV. CHONDRO-NEOPLASMATA.

GENUS I. CHONDROMA (*Cartilage Tumor*).

Species 1. Hyaline chondroma.
VARIETY 1. Osteo-chondroma.
VARIETY 2. Endothelio-chondroma.
VARIETY 3. Ino-chondroma.

The osteo-neoplasmata are osseous new-growths which arise from bone or periosteum or are developed in some of the connective-tissue tumors. They constitute the fifth order of neoplasmata, with one genus:

ORDER V. OSTEO-NEOPLASMATA.

GENUS I. OSTEOMA.

Species 1. Compact osteoma.
Species 2. Cancellated osteoma.
VARIETY 1. Endothelio-osteoma (*sarco-osteoma*).
VARIETY 2. Myeloid endothelio-osteoma (*myeloid sarco-osteoma*).
Subvariety 1. Teleangeiectatic myeloid endothelio-osteoma (*pulsating sarco-osteoma*).

The odonto-neoplasmata, *tooth new-growths*, constitute the sixth order of neoplasmata, with one genus and seven species. Transcribed from J. Bland Sutton's work on tumors, published in 1894:

[1] A lipo-inoma, commonly called lipoma and given a place among genera of new-growths, is in reality a fibrous tumor whose cells have become infiltrated and gorged with fat. Therefore it does not appear to merit a higher rank, in classification, than as a variety of inoma.

ORDER VI. ODONTO-NEOPLASMATA.

GENUS I. ODONTOMA (*Tooth Tumor*).

Species 1. Epithelial odontoma (*from the enamel organ*).
Species 2. Follicular odontoma
Species 3. Fibrous odontoma
Species 4. Cementoma[1]
Species 5. Compound follicular odontoma } (*from the tooth-follicle*).
Species 6. Radicular odontoma (*from the papilla*).
Species 7. Composite odontoma (*from the whole germ*).

The myo-neoplasmata are new-growths of smooth muscular tissue, and constitute the seventh order of neoplasmata, with one genus:

ORDER VII. MYO-NEOPLASMATA.

GENUS I. MYOMA.

Species 1. Leiomyoma.
VARIETY 1. Ino-leiomyoma.
VARIETY 2. Endothelio-leiomyoma.

The neuro-neoplasmata are new-growths of medullary or of fasciculated nerve-tissue, and constitute the eighth order of neoplasmata, with one genus:

ORDER VIII. NEURO-NEOPLASMATA.

GENUS I. NEUROMA.

Species. 1. Medullary neuroma.
Species. 2. Fasciculated neuroma.
VARIETY 1. Neuroglio-neuroma.
VARIETY 2. Myxo-neuroma.
VARIETY 3. Ino-neuroma.
Subvariety 1. Teleangeiectatic . . . neuroma.

The angeio-neoplasmata are new-growths of blood- or lymph-vessels, and constitute the ninth order of neoplasmata, with one genus:

ORDER IX. ANGEIO-NEOPLASMATA.

GENUS I. ANGEIOMA.

Species 1. Hæmatangeioma.
VARIETY 1. Cirsoid hæmatangeioma.
VARIETY 2. Cavernous hæmatangeioma.
Species 2. Lymphangeioma.
VARIETY 1. Cirsoid lymphangeioma.
VARIETY 2. Cavernous lymphangeioma.

The **diagnosis** of malignant disease in its late stage is comparatively easy, but in the early stage it is attended in many cases with extreme

[1] Cementoma is objectionable, owing to its hybridity. The growth described under that name by Mr. Sutton seems to be a true osteoma, and should be classified as a species of the genus osteoma. If it be a tooth-bone tumor, its proper name should be odont-osteoma.

difficulty. In every case many factors have to be carefully considered, since the tendency of malignant disease is to attack organs which are beginning to show degenerative changes, and especially in people who themselves have begun to show signs of physical decline.

The organs which conspicuously undergo degenerative changes are the sexual organs in women. The appearance of disease in these organs after forty points in nearly every case to malignancy.

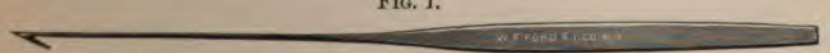
In men after forty-five certain tissues seem prone to the development of malignant disease, an example of which is seen in the mucous membrane of the mouth. In arriving at an early diagnosis of malignant disease the history of the patient must be carefully studied. Inquiry should be made to ascertain if the patient has received an injury, such as a blow or a fall, or has been subjected to some mental disturbance or anxiety, or has had an attack of severe illness.

In men the alcoholic habit, the existence of syphilis, the excessive use of tobacco are factors to be considered, since any or all of such agencies have a tendency to deteriorate the mucous membrane and other tissues.

The importance of the *early diagnosis* of tumors can only be appreciated when it is considered that human life often depends upon the surgeon arriving at an early and accurate decision. In every case of tumor the chronic infective diseases, such as syphilis and tuberculosis, should be considered and eliminated.

Gummata are removed not by surgical interference, but by constitutional remedies. In cases of doubt the administration of mercury and iodide of potash should be given a trial of at least six weeks as a differential diagnostic test. If the chronic infective diseases can be eliminated, the surgeon should endeavor to reach a conclusion by such means as by inquiry into the clinical history, by inspection and by palpation of the tumor, by a consideration of the age of the patient and the situation of the growth, by a study of its relation to surrounding parts, by the rapidity of its development, by the presence, nature, and degree of pain, and finally by the use of the harpoon (Fig. 1).

FIG. 1.



Harpoon for removing tissue for microscopical examination.

In regard to the clinical history of tumors in general, it may be stated that the history of a blow points to the development of hæmatocele and sarcoma. Continual and unnatural irritation often causes the development of papilloma, carcinoma, and neuroma. Infective processes point to the production of lupus, glanders, tubercle, gumma, and malignant pustule.

Congenital tumors, dermoid cysts, teratoma, and nævi are expressions of perverted development, the exact causes of which are unknown.

The time during which a tumor has existed should always be ascertained. The existence of a tumor, as far as the patient is concerned, means the length of time he or she has noticed the presence of the growth. This is often very misleading to the surgeon, since the tumor may have existed unrecognized for a long period of time. If too much

importance is attached to the statement of the patient, the surgeon may mistake a malignant neoplasm for a benign one or even an inflammatory disturbance. This question must be carefully weighed by the surgeon in his attempts to arrive at a correct diagnosis.

The manner in which a tumor is developed also throws light upon its character; thus a lump starting beneath the skin and eventually ulcerating points to a glandular affection, whereas a hard lump starting upon the surface of the skin, and not beneath it, and ulcerating, points to an epiblastic carcinoma.

The employment of the exploring needle has been greatly extolled by Middeldorpf, who applied to this test the term "akidopeirasty" (*ἀκίς*, a pointed instrument; *πείρω*, to pierce). If a suitable aseptic needle is thrust into a tumor, the course will be arrested if it impinges upon an exostosis; or if it penetrates a thin lamella of bone and enters a cyst, a central sarcoma is probably present, or if the needle enters a cavity whose walls are formed of a soft tissue, a cyst of some variety is in all probability present.

A translucent tumor points to a cyst, and the transmission of light through it can be tested by the use of a suitable lamp.

Auscultation and percussion can be employed with advantage in diagnosticating certain kinds of tumors. The presence of a bruit points to aneurysm, especially if the pulsation is expansile and not a simple pulsation, as occurs in tumors situated upon a large artery. If a tumor presses upon a large artery so as to narrow its lumen, a bruit may exist, which must not be mistaken for that of an aneurysm, which is transmitted along the artery for a long distance. Percussion elicits information as to the density of the tumor, while bimanual percussion gives a characteristic thud in case the tumor contains a large quantity of fluid.

It occasionally happens that a rasping noise very similar to a bruit is heard in a vessel whose lumen has been encroached upon by external compression due to the presence of a tumor.

In regard to the information obtained by palpation, it may be stated that a hard tumor points to the presence of fibroma, chondroma, osteoma, myoma, neuroma, sarcoma, and carcinoma, while a soft tumor points to a myxoma, lipoma, or angeioma. A fixed tumor points to a chondroma or osteoma, while a movable tumor is likely to be a fibroma, myxoma, lipoma, myoma, angeioma, or neuroma. Palpation also affords knowledge as to the mobility or fixity of the tumor to the surrounding structures. Palpation may even produce a certain egg-shell crepitation characteristic of central sarcoma. In such a case the thin layer of bone produced by absorption of the bone by the tumor crepitates under the manipulation.

In regard to the age of the patient, the malignant tumor of advanced life is carcinoma. Sarcoma, on the other hand, is the malignant tumor of early life, but may also be seen in exceptional cases in persons of advanced age. During adult life lipoma, fibroma, myxoma, chondroma, osteoma, myoma, angeioma, neuroma, and adenoma are among those chiefly found. There is one form of chondroma—viz. that affecting the digits—which is usually found in children.

The situation of tumors throws much knowledge upon the question of diagnosis. A primary malignant tumor of bone is always sarcoma, since carcinoma affects bone as a secondary disease. The lower jaw is

frequently the seat of sarcoma during early youth. A tumor in the female breast in a patient over forty-five years is usually a carcinoma, since sarcoma and adenoma generally affect the gland at a much earlier period.

A study of the relation of a tumor to surrounding parts demonstrates the fact of lymphatic involvement, which points to the existence of carcinoma, since dissemination in this tumor takes place through the lymphatic system. In sarcoma the metastasis is by the blood-vessels; hence lymphatic enlargement is seldom observed in this variety of malignant neoplasm or in any of the purely benign tumors. In the melanotic form of sarcoma, however, the lymphatic glands are often secondarily affected.

The rapidity of growth sheds much light on the diagnosis of tumors, since the malignant tumors, carcinoma and sarcoma, grow very rapidly, and the benign tumors as a rule develop very slowly.

The presence of pain is an important link in the chain of evidence as to diagnosis. In carcinoma and sarcoma pain is present as a rule. The character of the pain is also pathognomonic, since in the malignant tumors the pain is intermittent and lancinating, while pain is usually absent in all other tumors, unless possibly a simple tumor becomes inflamed from traumatism or a nerve-filament is involved in the mass during its slow growth.

In estimating the degree of pain the nervous temperament of the patient should be taken into consideration. For example, in neurotic females the expression of pain in adenoma of the breast is often very pronounced.

The use of the harpoon affords much valuable knowledge as to the diagnosis of any particular tumor. The examination of shreds of tissue from a tumor enables the surgeon to arrive at a probably correct diagnosis, especially if the clinical history corroborates the microscopical examination. An expert microscopist is not always willing to commit himself positively as to the existence of a sarcoma by the appearance of giant cells upon a slide, for these same cells are found normally in the medulla of bone; nor is he willing to assert absolutely the presence of a sarcoma or gumma because he finds before him hyperplastic connective tissue. The microscopical examination of a portion of the tumor previous to its removal is extremely valuable in diagnosis when taken in connection with the clinical history, but it is not to be relied upon as a single arbitrary measure to establish a diagnosis of the peculiar character of a tumor in every case.

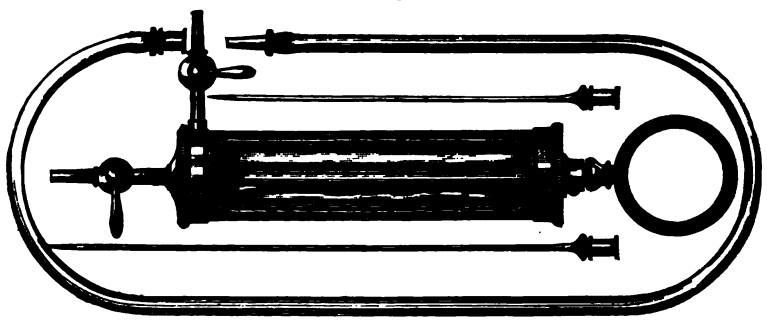
In a case of doubtful diagnosis between epithelioma and gumma, especially of the tongue, too much reliance must not be placed upon the result of a microscopical examination of small portions which are removed from the surface, since sections of the papillæ in a state of inflammatory hypertrophy may be mistaken for epithelial columns and globes.

The employment of the hypodermic needle attached to a small syringe (Fig. 2) is often of great value, since an examination of any abstracted fluid may enable the surgeon to complete the diagnosis. The failure to obtain fluid by the exploring needle must not be considered as positive proof that the tumor is essentially and entirely solid, inasmuch

as fluid may be imprisoned in a number of small cysts, or it may be of such consistency as to block the needle.

The consistence of a growth and the local temperature are important factors in arriving at an early diagnosis. Malignant tumors, as a rule,

FIG. 2.



Exploring needle with syringe for withdrawing fluid from cystic tumors.

are firm and hard, unless the growth is cystic, in which case the fluid gives to the tumor a sense of fluctuation.

The temperature of the part is not, as a rule, elevated in malignant tumors, unless there is some acute inflammatory action engrafted upon the tumor. In some forms of visceral sarcoma, however, an irregular temperature curve sometimes exists. Abscesses, on the other hand, are attended by elevation of temperature, which is most striking as compared with that which is occasionally observed in sarcoma. In abscess there a zone of induration which gradually subsides into the healthy tissue, and pyrexia is usually concomitant.

The prognosis in malignant tumors is subject to wide variations, and must necessarily depend upon a correct diagnosis. Tumors arising from inflammation must be first excluded, and then the different varieties of cysts, and finally a differentiation between benign and malignant growths, must be made before any prognosis can be established. In case of doubt as to the precise nature of any tumor no prognosis should be given. In case of certainty of the presence of malignant disease the prognosis should not be withheld from the family, but ought not to be communicated to the patient. It is a well-established clinical fact that cases which at first seem to be the most hopeless terminate in recovery. On the other hand, cases which apparently appear to be the most hopeful end in speedy death. The points upon which a favorable prognosis can be made are early recognition and radical operation. If a tumor can be removed within six months from its actual incipiency, the prospects of a permanent cure are most encouraging. The radical character of the operation is a most important factor, since the more freely the diseased tissue is removed with a wide area of healthy tissue the better the prognosis. In cancer the neighboring lymphatics should always be removed, and in sarcoma the entire bone, and in exceptional cases lymphatic nodes also, although usually the glands escape infection in the early stage of the development of sarcoma.

The special variety of sarcoma influences largely the prospects of

cure. Gross has shown that the spindle-cell form is supposed to be 43.5 per cent. more malignant than the central giant-celled, and the small round-celled most malignant of all.

The periosteal sarcoma is more malignant than the central. The round-cell variety, either in periosteal or central sarcoma, has a most serious prognosis, provided the tumor is not early removed. Melanosis increases the clinical gravity of the prognosis.

In carcinoma the melanotic variety is the most malignant, and next the encephaloid and colloid. The last in the descending scale is scirrhus, and then epithelioma, and finally rodent ulcer.

The situation of the malignant disease has an important bearing upon the prognosis, since those cases in which the neoplasm is accessible to operative interference without great danger to life itself are more favorable than those in which the disease affects the viscera, and in which the growths cannot be removed without adding the mortality of a prolonged and difficult abdominal section. Surface epithelioma offers a better prognosis than epithelioma situated in a gland or an organ, since in the former case the growth extends only in one direction, while in the latter case the growth extends in many.

The manner in which the situation of a tumor affects the prognosis is seen in an exostosis upon the outer surface of the skull, which produces no disturbance, whereas the same kind of a growth situated upon the inner surface of the skull may cause fatal pressure-effects. Application of this same rule may be applied to all kinds of tumors, and the result is practically the same. A benign tumor may have a serious prognosis if its situation is such as to produce pressure upon important vessels and organs, or if the growth itself becomes the seat of microbic infection.

The prognosis is always favorable in benign tumors if the growth is completely removed. In the case of malignant tumors there are many unknown factors which compel the conscientious surgeon to withhold a favorable prognosis until at least three years have elapsed since the operation. The earlier and the more radical the operation the better the prognosis. Finally, the existence of certain types of malignant tumors enables the surgeon to give a more favorable prognosis than he could give in certain other types of malignant disease.

In Dr. Gouley's interesting article on the prognosis of tumors, read before the New York State Medical Association in 1895, from which the writer quotes with permission, he says: "For the consideration of those who may wish to make further researches into this subject it is proper to note that, since benign tumors by regression are transformed into malignant tumors, it is not unlikely that malignant tumors by progression toward a higher organization are sometimes transformed into benign tumors, or at least into tumors which remain quiescent for long periods of time. The behavior of the so-called 'atrophic carcinomata' appears to justify this view. The tumors named atrophic carcinomata because of their tendency to decrease in size, to contract like scar-tissue, owing to sclerous degeneration of their fibrous tissue, are rightly regarded as less malignant than other forms, and often last many years without involvement of lymph-glands or doing any mischief whatsoever.

"The probable reason why in these 'atrophic carcinomata' the lymph-glands are not implicated is that it cannot be easy for the em-

bryonic epithelial cells to multiply and migrate, owing to their being, as it were, imprisoned in the dense sclerotic tissue. Ulceration can only set them free to do mischief. Thus an adenoma may at the time of greatest proliferation of its epithelial cells, at the very time of its transformation into a carcinoma, receive an abundant accession of endothelial cells, which rapidly progress into fibrous tissue greater in amount than the epithelial cells, the fibrous tissues soon undergoing sclerous degeneration. Such may be the right explanation of the origin and apparent harmlessness of 'atrophic carcinomata.' What may be the exact excitant of this progressive metamorphosis and of the subsequent sclerous degeneration, of this effort of nature to effect a cure, has not yet been ascertained."

The spontaneous disappearance of tumors from the body has been observed by several eminent authorities. Dwight reports a case of complete subsidence of a pelvic tumor in which abscess was eliminated and gumma was excluded by the administration of iodide of potash. Sands also reported a case of a large tumor of the left groin which completely disappeared, so that at the autopsy no trace of the tumor could be found except a superabundance of connective tissue. Esmarch has reported cases of recurring fibroid tumor disappearing under the use of iodide of potash. Duhring reported a case of inflammatory fungoid neoplasm which involved the chorion, and which spontaneously disappeared. Coats presented specimens before the Pathological Society of London, in which Sir James Paget remarked that "the report of such a case was useful as likely to help in the explanation of those rare instances in which tumors diagnosticated to be cancerous had disappeared after a time." Three cases of this kind were observed by Sir James Paget. Fischer has shown that certain tumors have been known to disappear spontaneously in consequence of some serious illness, or, if not to disappear, at least to become greatly reduced in size. Among these tumors he mentions sarcoma, adenoma, and lymphatic enlargements. Cheever reports twelve cases of miscellaneous tumors that disappeared either spontaneously or as the result of the administration of potash, arsenic, iron, and bichloride of mercury.

Although there seems to be some reason to believe that tumors proper may disappear spontaneously, the fact remains that they very rarely do so, and such inference should only be drawn where the diagnosis has been established beyond question and the subsidence has been complete, or, if partial, that it was not of some complicating inflammatory enlargement. It should be always borne in mind that the more chronic a case of scirrhous cancer the more does it undergo cicatricial contraction. This contraction must not be considered in connection with spontaneous subsidence or disappearance.

The treatment of tumors is divided into medical and surgical, and recently inoperable tumors have been treated by a special method in which the toxines of erysipelas and of the bacillus prodigiosus have been injected with a view of causing degeneration and absorption of the neoplasm.

The surgeon can expect little or nothing from internal medication in the treatment of tumors; however, a brief review of the drugs that have been employed may not be amiss.

Boerhaave recommended mercury; Lefebvre as far back as 1775 used arsenic; Duportel and Duparcque administered various preparations of gold; Weise in 1829 advocated the use of animal charcoal; Störk in 1761 gave the preparations of conium maculatum; Valsalva and others suggested venesection; and Turenne recommended syphilization. Bennett employed ice to malignant tumors as far back as 1850, but the result was only to retard the growth.

Among some of the remedies employed may be mentioned red-clover tea, tincture of thuya, also hydrastis, the latter in fifteen-drop doses three times daily for a long period of time. The internal use of Chian turpentine, as recommended by Clay, has on the whole failed to realize the benefits which he claimed for it. As a curative agent it is practically useless, but in some cases the writer has found that it relieves pain and has a tendency to control hemorrhage.

The *surgical treatment* of tumors is directed to their complete removal, since nothing can be expected from the internal administration of drugs, except in some cases of inflammatory lymphatic enlargements where the use of arsenic is often beneficial.

The so-called gummy tumors are really inflammatory neoplasms, and not new-growths, and do not come within the scope of this subject.

Tumors are removed to prevent pain and inconvenience and the possibility of damage to subjacent organs; for the relief of hemorrhage; for psychical reasons; and even for cosmetic effects. Finally, benign tumors are excised because of the possibility of malignant degeneration. These reasons are unimportant in comparison with that of saving human

FIG. 3.

Paquelin thermo-cautery.

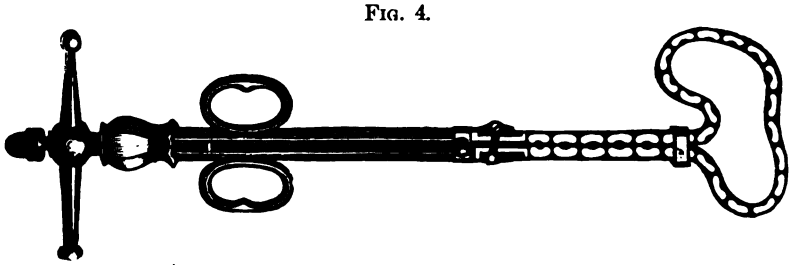
life. In every case it is advisable to remove tumors from the body, since no one can foretell what the result will be if any tumor is left in the economy.

In ancient times the actual cautery was employed, and even to this

day this method possesses many superior advantages. Under anæsthesia the tumor can be quickly removed and with no danger from hemorrhage. The surface epithelioma and the rodent ulcer are the varieties of malignant disease the treatment of which meets with the best results by the actual cautery. The best instrument employed for the application of this method is the well-known Paquelin cautery (Fig. 3), and in patients in whom there exists an inherent dread of the knife this plan of treatment is often attended with excellent results. The base of any malignant ulcer requires the actual cautery to render even the operation of excision effective.

Ligature of a tumor has been employed. The ligature is placed about the root of the tumor, and the growth, thus deprived of blood, undergoes rapid necrosis. This method was formerly employed only in pedunculated tumors, as far back as the time of Ambrose Parè, but in recent years the use of the ligature was extended, mainly through the writings of Mayor, to include sessile growths. The multiple ligatures were used in these cases, notably in vascular tumors. This same method is also employed by means of special instruments devised with a view to constricting the growth at its base. In this connection may be mentioned the method by crushing with an écraseur, which was introduced by Chassaignac (Fig. 4). Amputation of the tongue and penis has

FIG. 4.



Écraseur for removal of tumors, crushing the pedicle.

been performed by this method, but the results are not satisfactory. The writer has removed several pedunculated tumors by ligature in the form of elastic bands, which were applied to the pedicle after a method suggested by Nathan R. Smith, and practised quite extensively by the late James R. Wood. Ligature of a main artery leading into the tumor has been tried with success in some cases and failures in others.

Avulsion of the tumor has been performed by seizing it with a pair of forceps and twisting the pedicle around the axis, thus tearing it forcibly from its attachments to the body.

Cauterization in the treatment of tumors must be mentioned, in order not to omit any of the usual means employed. Caustics, as a rule, should not be used except by those who understand the peculiar manner of application. They can be tried when operative interference is impossible or for the purpose of encouraging a sloughing mass to come away from the body. Caustics are often employed with advantage in conjunction with operations upon the bone. In malignant disease of the orbit, after the soft parts are freely excised the application of the caustic is of advantage. The deliquescent crystals of chromic acid have been

often employed by the writer in cases of deep-seated epithelioma after free removal with the knife. In conjunction with operative interference the use of the last-named caustic is often of great benefit.

The use of caustics is attended with severe pain, which often lasts for some time. The preparation generally used is Mance's paste, which consists of fifteen grains of white arsenic, seventy-five of cinnabar, and thirty-five of burnt sponge, which are rubbed up into a paste by the addition of a few drops of water. Chloride of zinc is often used also in the form of a paste, which is made by adding to one part of chloride of zinc three or four parts of flour and a few drops of water. Whatever variety of escharotic is used, the caustic should not be applied, as a rule, directly to the skin, but only to an ulcerating surface. The skin about the ulceration should be protected by rubber plaster. In some exceptional cases it is best to apply the caustic at a distance from the growth, and to encourage a large slough, including a wide area from the diseased mass.

Escharotics are useful in superficial lesions and never indicated in deep-seated ulcerations. The potassa fusa is excellent, because its caustic effects can be controlled by the use of vinegar, which causes it to cease its action and at the same time relieves the pain.

Injections have been used for the purpose of destroying and removing tumors, among which may be mentioned ergotin, arsenic, nitrate of silver, osmic acid, and phosphorus. Turpentine in equal parts with absolute alcohol is often used, or one part of turpentine to two parts of alcohol. Of these last two preparations a syringeful can be injected into the tumor every ten to twelve days (Fig. 5). Osmic acid is used

FIG. 5.

Syringe for injection of fluids into tumors.

also as an injection in three-drop doses of a 1 per cent. solution. Fowler's solution can be used in like manner undiluted in two-drop doses. Arsenic is used also in the form of a paste, known as Frère Côme's paste, which has been found useful in epithelioma and rodent ulcer.

A concentrated solution of the crystals of chromic acid is also employed as a caustic. It is said to cause less pain than the other caustics.

Maisonneuve in 1857 practised another form of cauterization, which consisted in introducing into the tissues by puncture some caustic. The caustic is applied to the base of the tumor by inserting arrow-shaped pieces of chloride-of-zinc paste in small openings made with a bistoury. The arrows are also introduced vertically around the tumor, and generally are thrust through the centre of the tumor.

In carcinoma of the breast Jarvis Wight recommends the persistent use of arsenic bromide internally. The dose is from one-fortieth to one-tenth of a grain, beginning with the smaller dose and gradually

increasing it. In conjunction with the arsenic bromide a solution of gold is used in doses of from five to fifteen drops after meals. Calcium carbonate has also been given as an adjuvant to the other remedies, but in itself is inferior to the arsenic bromide.

The injections of the aniline dyes, especially the blue pyoktanin, have been employed in the treatment of inoperative malignant disease. This method was introduced by Von Mosetig-Moorhof in January, 1891. Pyoktanin is one of the methyl violets. The strength of the solution for hypodermic injections is 1 : 500, and it should be made fresh, and then temporarily kept in a glass-stoppered blue bottle. The drug can be used in a stronger solution for external application, or the pure drug can be dusted over an ulcerated surface. The injections should be made under the most rigid antiseptic precautions, which include preparation of the field of operation and sterilization of the needle by boiling. The quantity to be injected varies from one-half a drachm to three drachms. The oozing after the withdrawal of the needle is controlled by a pledget of antiseptic gauze. The injections should be employed every other day. Von Nussbaum has tied the afferent vessels prior to the injections. Dr. Willy Meyer has tabulated the results in an interesting monograph upon the subject. He claims for this drug no expectation of permanent cure, but relief of pain and partial restoration of function of the part. Von Mosetig reports several cures from the use of this drug. Nunn, Lindner, and others have also reported cures. Dr. Meyer's conclusions are that "the use of the aniline dyes in the treatment of inoperable carcinoma (malignant growths) generally is a palliative treatment. In very rare cases this treatment may cure." The writer has employed this method, but the results are such that he is not justified in commending its use except in rare cases.

Nussbaum has highly extolled the use of the thermo-cautery. His plan is to use the cautery around the periphery of the growth, and by complete circumcision cause the tumor to undergo an atrophy. The pain subsides, the ulcerations are checked, and the foul smell is controlled. If the sloughs come away, the thermo-cautery is applied to the base of the ulcer, and in this manner the unhealthy granulations are all destroyed.

Electrolysis has been employed in the treatment of tumors. The results of treatment by this method are, as a rule, unsatisfactory. Neftel reports a case of cancer of the male breast cured by the use of electrolysis. He used "the large apparatus of Krüger and Hirschman with elements of Siemens, subdividing at the second and third operation the cathode into three and four branches, connected with the needles by serres-fines." The discoverer of this treatment was Crussel of St. Petersburg. He treated tumors by electrolysis as early as 1839. Meyer of Berlin and Dr. Althaus have improved the technique, and the latter has pointed out the great importance of the negative pole.

In the treatment of tumors electrolysis acts (1) through mechanical disintegration of the tissues, setting the hydrogen free; (2) through the dissolving action of the accumulated free alkali (potash-soda lime); (3) through the local modification of nutrition by means of the vasomotor nerves of the parts brought under the immediate influence of the current. (For a full description of the treatment of tumors by electrol-

ysis the reader is referred to Neftel's articles published in vols. lvii., lxx., and lxxxvi. of *Virchow's Archiv.*)

In ulcerated surfaces a lotion composed of eight grains of the chlorate of potash and two minims of strong hydrochloric acid to an ounce of distilled water has been applied with signal benefit.

Instead of the chlorine lotion just mentioned, a powder of manganese potash can be sprinkled over the ulcerated surface. This powder is made by mixing manganate and the permanganate of potash, and has a very marked effect upon the ulcerating surface by its power of oxidizing dead animal tissue and thus depriving the ulcer of its foul smell.

In cases of secondary hemorrhage from the ulcerated mass dry lint soaked in the perchloride of iron and pressed only over the bleeding point is the best styptic for general use in these cases. Monsel's solution can be substituted for the perchloride of iron. These strips of lint should be removed after a few hours.

The pain in malignant disease is often relieved by opium in some form. Hypodermic injections of morphine are useful in most cases, and in a few of no practical utility. The surgeon must bear in mind that morphia once begun must be continued to the end, and this fact should influence him in beginning the use of the drug. There are many objections to the administration of morphia in these cases, and it should only be resorted to when all other means have failed and when the pain is constant and severe; but when these indications are present the drug should not be withheld.

Topical applications of cocaine, of lead-and-opium wash, of extract of conium, of Chian turpentine, of belladonna, and of other like drugs have often proved efficacious in relieving the pain.

The division of nerves distributed to the part has often afforded marked relief in the pain of malignant disease, as, for example, the gustatory in carcinoma of the tongue.

The possibility of curing malignant tumors has been shown by the work of Rose of Zurich. He operated upon 298 cases of malignant tumors between the years 1867 and 1878, and Meyer was able to collect data in reference to 64 of the cases. In 1887 there were 22 cases alive without recurrence, although the period of immunity embraced a period of from nine to twenty years. In this list of tumors there were some of a very serious nature which required a most formidable operation. Hardaway has reported some cases of sarcoma and melano-sarcoma affecting the skin where spontaneous retrograde changes have occurred, which terminated in complete cure of the disease. Bosworth and others have also reported cases of sarcoma of the tonsil which have been permanently cured.

The writer has published a series of cases of malignant tumors in which he has operated and which have been permanently cured. At the present time at least three years, and in the majority of the cases ten or more years, have transpired without recurrence. The list includes 24 cases of sarcoma, 15 cases of carcinoma, 10 of epithelioma, making in all 49 cases. To this list many other cases can soon be added, but which are at present debarred from the list on account of a three-year time limit. In each of these 49 cases a complete history is preserved, also the original tumor, with a written diagnosis by a professor of

pathology, also the names of the physicians who were present at the operations. These cases place beyond all doubt the possibilities of permanent cure in malignant disease. In this group the cases of malignant tumors of the breast are not included, hence they are discussed separately under Tumors of the Breast.

The treatment of inoperable tumors by the injection of the mixed toxines of erysipelas and bacillus prodigiosus has been carefully studied by Coley, the author of the method, whose interesting articles upon this subject are worthy of study. In the present state of our knowledge no positive opinion can be given as to the efficiency of this method: it will suffice in this connection to give a summary of the method, with the latest results, and defer any positive conclusions until more clinical data are presented. Coley's earlier method consisted in using the filtered toxines, prepared by growing the erysipelas streptococci in bouillon three weeks, then filtering through porcelain, and preserving by adding thymol. The toxines of the bacillus prodigiosus were prepared in the same manner, and the two were mixed at the time of using. Later the erysipelas streptococci were cultivated in bouillon for three weeks, at the end of which time the bacillus prodigiosus was added, and the two germs allowed to grow together for an additional period of ten days, and subsequently filtered. Four of Coley's successful cases were treated by this method. The method of filtration made it possible to utilize only the soluble products; hence in order to obtain whatever virtue might exist in the bodies of the germs themselves the cultures were sterilized, without filtration, by subjecting them to a temperature just sufficient to kill the germs without having any material influence upon the toxines themselves. This temperature was found to be about 58° C. This preparation Coley found to be very much more powerful than the others, and his experiments with it during the past two years seem to have proved it to be more efficient.

The strength of the toxines depends entirely upon the virulence of the cultures from which they are made. To be of any value the streptococcus should come from a very virulent case of erysipelas. The preparations employed by Coley were made from cultures originally obtained from a fatal case of erysipelas, and the virulence of these cultures has been maintained by frequently passing then through rabbits. The toxines prepared from such mixed cultures are extremely powerful, and not more than one minim can ordinarily be given with safety at the first injection. Coley has observed a temperature of 104.5° F. follow the injection of half a minim when injected into a vascular tumor. The amount of reaction depends very much upon the rapidity of absorption, so that comparatively large doses injected subcutaneously remote from the tumor will produce less reaction than a fraction of a minim injected into a vascular tumor. As a rule, where possible, the injections have been given locally or in the vicinity of the tumor, although this is not absolutely essential. In most of the successful cases the tumors disappeared entirely by absorption, though in two cases more or less necrosis and discharge occurred. A reaction of temperature of 101° to 104° has been regarded as necessary to produce satisfactory results.

The exact method of preparation will be given from Coley's own article, in which Buxton has furnished the description: "To make the

toxines of erysipelas and prodigiosus ordinary peptonized bouillon is put into small flasks, containing 50 to 100 c.c., which after proper sterilization are inoculated with the streptococci of erysipelas and allowed to grow for three weeks at a temperature of 30° to 35° C. The flasks are then inoculated with bacillus prodigiosus, and the cultures allowed to grow for another ten or twelve days at room-temperature. At the end of that time, after being well shaken up, the cultures are poured into sterilized glass-stoppered half-ounce bottles and heated to a temperature of 50° to 60° C. for an hour, sufficiently to render them perfectly sterile. After cooling a little powdered thymol is added as a preventative, and the toxines are ready for use. The toxines when prepared in this way are very much stronger than when filtered through a Pasteur, Chamberland, or Kitosato filter, the acute principles contained in the germs themselves being preserved. If, as is sometimes the case, the preparation is found to be too strong to use with safety, it can be diluted with glycerin or sterilized water. The best method of making the bouillon is to soak a pound of chopped lean meat over night in water. In the morning strain it through a cloth, make up to 1000 c.c., and boil for one hour. Then filter through a cloth, add peptone and salt, neutralize, and boil again for an hour. The bouillon will then pass through filtered paper perfectly clear and ready to be put into the flasks. It is not, however, necessary to neutralize the bouillon, as the streptococci will grow even more readily in acid bouillon, and the resulting preparation is, if anything, stronger than when neutralized bouillon is used.

"In order to keep the virulence of the cultures they are put through rabbits in the following way: The hair of the ear is clipped close with a pair of scissors, and the skin washed with weak carbolic acid and then sterilized water. A minute quantity of a bouillon culture, forty-eight hours old, is then injected subcutaneously in four or five different places in the ear. Forty-eight hours later, after again washing the ear with carbolic acid and sterilized water, a flat needle, sterilized in the flame, is inserted under the skin at or near a point of inoculation, and the layer of the skin cut off with a sharp sterilized scalpel. The piece of skin is then rubbed well over the surface of an agar tube with a thick platinum-wire needle. After twenty-four hours in an incubator the colonies of streptococci will show as minute white specks, and from them a pure culture can be obtained. If the agar is made with 75 per cent. of bouillon and 25 per cent. of urine, the streptococci will grow more freely than if bouillon alone is used."

Coley gives this injection in doses from one to eight minims, and states that he has observed a temperature of 105° F. to follow an injection of two minims. The minimum dose is given, and gradually increased until a reaction of 103° to 104° F. is reached.

Since May, 1891, Coley has treated 100 cases of inoperable malignant tumors with the following results: 66 of these cases were sarcoma; 28 were carcinoma; 4 were sarcoma or carcinoma; and 2 tubercular, the diagnosis of sarcoma having been previously made. Of the cases of sarcoma, more than half showed improvement more or less marked. The variety of sarcoma which showed the greatest effect of the treatment was the spindle-celled (Figs. 6 and 7), and that showing the least effect the melanotic. Next to spindle-celled in the order of benefit come

the mixed celled, then round-celled, then osteosarcoma, closely approaching melanotic in showing but little effect from the toxines. In a series of 6 cases of melanotic sarcoma no improvement was observed in 3 cases,

FIG. 6.

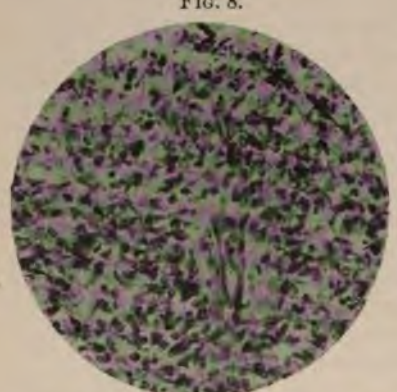
Osteo-sarcoma of ilium, before treatment (Coley).

FIG. 7.

Osteo-sarcoma of ilium, six months after treatment. This case recurred later, and the tumor is now, March 11, 1896, of enormous size (Coley).

and but slight temporary improvement in 3 others. In 3 of these cases, however, tumors were multiple, and the disease thoroughly generalized before treatment was begun. In osteosarcoma the results were scarcely more satisfactory. Most of the cases showed slight improvement, and one case—a very large osteochondro-sarcoma of the ilium—was apparently cured, and remained well for nearly a year, when the tumor recurred, and reached nearly its former size within a few months. The toxines were again tried, with less effect than before. The tumor decreased very considerably in size, and general health improved, but the improvement was only temporary.

FIG. 8.



Round- and spindle-celled sarcoma, well three years after treatment with mixed toxines, erysipelas and B. prodigiosus (Coley).

Round-celled Sarcoma. — Coley has had no cures in pure round-celled sarcoma, although one case of mixed, round, and oval-celled sarcoma was well, without recurrence, three years after treatment. Many of the cases of round-celled sarcoma (Fig. 8) showed very great improvement, which, however, proved only temporary. Nearly all of Coley's successes have been cases of spindle-celled sarcoma (Figs. 9, 10, 11). Coley has had, up to January, 1896, 10 successful cases of

inoperable malignant tumors treated by this method; 7 of these cases

FIG. 9.

Twice recurrent, totally inoperable angio-sarcoma of breast: (1) before treatment (Coley).

were well from one to four years after treatment. In 3 cases of appa-

FIG. 10.

(2) After six months' treatment with erysipelas and B. prodigiosus serum. Serum prepared from horse in same way as diphtheria antitoxin serum (Coley).

rent success relapse occurred in one case seven months after treatment,

and in the other one year. Four of the cases have remained perfectly well from two to four years after treatment. These cases were all so advanced that they had been pronounced inoperable by leading surgeons, and the diagnosis was confirmed by a microscopical examination by the most competent pathologists. The oldest case, a twice-recurrent sarcoma of the neck and tonsil, was in perfect health four years after treatment.[1] A second case, a large sarcoma of the back and groin, was in perfect health more than three years after the beginning and nearly three years after the cessation of treatment. A third case, a large sarcoma of the

FIG. 11.

(3) Tumor as seen in Fig. 10, removed by operation. Fig. 11, wound healed (Coley).

abdominal wall and pelvis, was well nearly two and a half years after treatment, and a fourth case, a large sarcoma of the abdominal wall, was well two years after. Coley has had two cases of epithelioma that were apparently successful, although sufficient time had not elapsed to determine whether or not the cure would be permanent. In one case of epithelioma, involving the chin, lower jaw, and floor of the mouth, the patient was alive and in perfect health, with no traces of the disease, one year and a half[2] after treatment (Figs. 12 and 13). Another case of

[1] This case was treated with repeated injections of living cultures of erysipelas alone.

[2] The microscopic examination in this case was made by Dr. W. N. Belcher, the pathologist to the Methodist Episcopal Hospital of Brooklyn. The examination was from frozen sections, and not "entirely" satisfactory, but the diagnosis of epithelioma was made. This case had been once operated upon, and was sent to Coley by Dr. George R. Fowler as an inoperable epithelioma.

recurrent epithelioma of the face was well seven months after treatment. In general, the results in carcinoma have been very much inferior to those in sarcoma. In addition to Coley's cases there have been at least six[1] well-authenticated successes in the hands of other well-known surgeons in the United States who have used this method. Czerny[2] of Heidelberg has recently reported eight cases treated by Coley's method. Four of the cases were carcinoma, and showed very little effect; four

FIG. 12.

Epithelioma of chin, lower jaw, and floor of mouth. Photo two weeks after treatment. The ulcer was the size of a silver half-dollar before treatment (Coley).

FIG. 13.

Epithelioma of chin, lower jaw, and floor of mouth. Inoperable. Photo taken sixteen months after treatment (Coley).

were sarcoma, one of which, a round-celled sarcoma of the parotid the size of the fist, nearly disappeared after eighteen injections.

The technique is still far from perfect, and it has been found extremely difficult to produce any preparation of the toxines that will give uniform and constant results.

This method is as yet too immature, the technique too little understood, and the cases not long enough under observation to express an exact opinion as to its merits. Without doubt this method of treatment has much value, and time only can decide the position which the profession will assign to this plan of treatment. At all events, the almost miraculous results which have been obtained in some cases of inoperable sarcoma justify the means, and offer to the profession sufficient encour-

[1] Two of these cases have been published (Johnson), *Med. Record*, Nov. 17, 1894; (Mynters), *ibid.*, Feb. 9, 1895. One was well in Jan., 1896, more than two years after treatment. The other was well in Feb., 1896, one year after treatment.

[2] *Münchener medicinische Wochenschrift*, No. 36, 1895.

agement to investigate still further this unique method. Coley himself has only advocated its use in inoperable sarcoma. The results in carcinoma are not so satisfactory, but in time it is possible that in this variety of malignant tumor the results will be like those in sarcoma.

The treatment of malignant disease by operative interference is the method that yields the most satisfactory results, and it is on the radical character of the operation that success depends.

The term "radical" is susceptible to a wide range of meaning, since what might be considered a radical operation by some would be regarded by others as entirely inadequate.

A sarcoma of the tip of the external malleolus requires more than amputation of the leg, since the popliteal glands are occasionally affected, and therefore amputation of the leg at the knee-joint is clearly inadequate in such a case. A supracondyloid amputation of the thigh is necessary in order to get rid of the chain of lymphatic vessels and the popliteal nodes in structural connection with the tissue from which the growth springs. Ten years ago the writer adopted this method in a case of small round-celled sarcoma of the external malleolus. This tumor was examined by Prof. Welch of the Johns Hopkins University, and pronounced by him at that time a most malignant form of sarcoma. The patient from whom this tumor was removed by a supracondyloid amputation is still alive and with no return of the disease.

Only recently the writer has observed two cases which are in marked contrast to the one just described, and which serve as forcible examples of the necessity of the radical operation which has just been explained. In both cases the sarcoma involved the lower end of the external malleolus. The growths were excised, but recurrence quickly followed, and the popliteal lymphatics became enormously enlarged. The disease then invaded the inguinal glands. In these cases, an exact counterpart of the one just referred to, it is almost certain that early amputation just above the condyles, with removal of the popliteal lymphatics, would have prevented a local and a regional recurrence, and death itself. It may seem too radical to sacrifice so much of the body for what might appear at first so insignificant a growth, yet clinical history repeats itself over and over again that death is the alternative unless an early and a radical operation is boldly resorted to as a curative measure. Sarcoma destroys life in every case unless the tumor with the lymphatics are completely eradicated by an early operation.

In performing a so-called radical operation for the removal of cancer it is often a question as to how much glandular tissue it is necessary to dissect out from the adjacent tissues, and especially what particular glands need removal. In certain cases it is useless to remove some near-lying and large glands and omit the small chain of lymphatics which shoot off directly from the infected area.

In epithelioma of the lip there is situated near the angle of the jaw a gland which is in connection with the labial glands. This small gland should be dissected out, even though the larger and submaxillary gland just beneath it and the jaw are apparently free from infection. The neglect to do this is often the cause of a recurrence of the cancer of the lip even though the submaxillary gland has been extirpated. At the suggestion of the writer Prof. Gerrish has made a unique and beautiful

set of plates showing the direct line of infection from any given point in the body. An examination of the chart in his article in Vol. II. at once reveals the points of attack that the surgeon should make after the free removal of a primary growth. Dr. William C. Lusk has dissected out this gland, a photograph of which is given in order to show the avenue of infection in an ordinary epithelial cancer of the lip (Fig. 14). This

FIG. 14.

Dissection showing infection of small glands beneath the jaw in epithelioma of lip prior to infection of the larger and submaxillary gland (Lusk).

gland always becomes infected before the submaxillary, and the absence of infection in the former precludes the presence of metastasis in the latter. At this juncture another question arises of great importance: If a radical operation is performed and recurrence takes place, is there any prospect of permanent cure by repeated operation? In such a case the writer feels justified in advocating the plan that operations should never be abandoned as long as the growth can be removed and no viscera are involved. This suggestion has reference not only to mere prolongation of life and to the amelioration of physical suffering, but it also has a direct bearing upon the ultimate and permanent cure. There are some good illustrations of this law in the older works upon surgery.

Mott operated fifteen times in one case of sarcoma during a period of twenty-three years. Gross operated twenty-three times in a case of sarcoma during a period of four years. The writer has removed in the same patient first an axillary sarcoma, then the mammary gland, and later several sarcomata situated in the inguinal region. These repeated and in some cases severe operations, extending over several years, have finally effected a permanent cure in this case, as now over three years have elapsed without any evidences of a local or regional return or any secondary deposit in any of the viscera. A failure to have operated in any of these multiple sarcomata would have abandoned the patient to certain death. Repetition of the operation in different parts of the body has at last rescued the unfortunate victim of this dreadful disease and has placed her beyond the probable chances of death from sarcoma. The writer has now under observation a patient from whom he removed the breast several years ago, and at different intervals over one hundred carcinomatous nodules. At the present time there is no evidence of return, although three years have not yet elapsed since the last operation, but

sufficient time to afford encouragement in the hope that no further trouble will follow.

Early diagnosis, radical operation, and repetition of operation as often as circumstances permit are the important factors involved in the management of malignant disease. The line of operative treatment is therefore plain and explicit to any surgeon who desires to attain the best possible results.

Finally, in assuming the care of a patient suffering from malignant disease it is best at the start to inform the friends, but not the patient, of the real dangers. It is well also to refuse to take all the steps necessary to arrive at a correct diagnosis unless assurances are given by the friends that the patient will be persuaded to abide by the result. For example, it often happens that in consequence of using the harpoon or even the exploring needle a fungous growth starts up immediately, and the patient becomes dissatisfied and abandons the surgeon to take the advice of some charlatan or quack. The harpoon should not be used unless it is distinctly understood that if the result of the examination demonstrates the presence of sarcoma permission will not be withheld to perform a necessary and radical operation, or, if permission is not granted, to exonerate the surgeon from any responsibility for the rapid fungous growth which often follows the use of the harpoon.

In studying the nature and history of malignant disease the only safety lies in early diagnosis, in a radical operation, and in a repetition of the operation if necessary.

The writer desires to place great stress upon the doctrine that all tumors, whether benign or malignant, as well as all keloids and tight cicatrices, should be removed. Benign tumors should be extirpated, because a certain proportion of them undoubtedly degenerate into malignant tumors. This change is apt to occur at special crises or periods of life, or at a time when physiological atrophy takes place in an organ, as in the female breast after the menopause.

Another reason why supposed benign tumors should be excised is that certain malignant tumors remain quiescent for many years, and for this reason give rise to the supposition that they are innocent growths, when in reality they are latent malignant neoplasms. The danger of leaving a supposed benign tumor becomes evident when it is considered that only a small minority of tumors in general are harmless. Gross collected 649 cases of tumors of the breast, of which 587 were malignant and 62 innocent. The writer has knowledge of a case of pure enchondroma which had existed for twelve years. It was apparently, to all intents and purposes, a perfectly benign growth. At the expiration of this period of benignancy the tumor began to increase rapidly, and in six months doubled its size. The tumor was removed and proved to be a round-celled sarcoma. A practical illustration of this kind serves to impress the important fact. It follows, therefore, that the mere presence of a tumor in the body, especially in the breast, argues in favor of its malignancy, and for that reason the growth should not be permitted to remain. There is no benign tumor in which it has not been demonstrated that it may not assume malignancy under favorable conditions. This last sentence explains the necessity of such extreme radical views as to the management of all varieties of tumors. Keloids should be

removed, since they are the starting-point of malignant disease. Moles and patches of psoriasis that are incurable better be also excised, since they may degenerate into malignant neoplasms. The fact of epithelioma starting from a cicatrix of a gunshot wound is suggestive of the fact that all cicatrices with tension should be removed to avert the dangers of malignant degeneration.

Sero-therapy has been highly commended in the treatment of malignant tumors. The writer has been unable to find any permanent cures by this method, and, in fact, sufficient time has not elapsed to justify the conclusion that the remedy is certain or that it will effect a lasting cure in any case. Cancerous serum has been employed on many patients, but in no case has a cure been effected, although improvement in the symptoms has been recorded. The whole subject of sero-therapy is still in its infancy, and nothing can be stated with positiveness at the present time. The profession awaits with great interest the outcome of this method of treatment, since there is no doubt that future experimental work will prove the great value of this remedy.

In speaking of sero-therapy in cancer Ferré says "that after the injection of anticancerous serum there is a considerable diminution of the borders of the ulceration, with a lessening of the peripheral congestion and a reduction in the size of the ulcerative offshoots, although the ulceration itself does not cease to spread." Time alone is necessary to establish this treatment upon a firm basis or to expose the inefficiency of the treatment in the management of malignant disease.

Special Tumors.

Lipoma (λίπος, fat) is a benign tumor consisting of fatty tissue which appears in lobules the same as in normal fat, except that both the lobules and the fat-cells are much larger than normal. A lipoma is usually solitary, although occasionally lipomata are multiple. This tumor must not be confounded with obesity or any general tendency to fatty deposit. The tumor is essentially benign, but occasionally it is combined with sarcoma, in which case it becomes malignant. A lipoma, especially in children, is occasionally mixed with erectile tissue, and such a growth has been termed nævoid lipoma.

A lipoma may be circumscribed or diffuse (Figs. 15 and 16). In the former case it is entirely surrounded by a capsule, while in the latter case there seems to be no special covering, but the fatty growth becomes blended with the normal fat of the part and the mass appears as an ill-defined outgrowth of fat.

Lipoma is usually observed between the ages of thirty and fifty. It is slow-growing, and is attended with no pain unless a nerve is involved in the growth, or the nerve is stretched on account of the size of the tumor, or the tumor itself becomes acutely inflamed from traumatism.

The tumor is freely movable under the skin, and possesses a well-defined capsule of fibro-cellular tissue, the interior of which sends out partitions which form cavities in which the fat-cells are found. The skin is often adherent to the capsule, and thus a puckering of the integument or a dimpling of the skin occurs, which is characteristic of lipoma. At times

the tumor glides freely under the skin, and the integument can be caught

Fig. 15.

Lipoma, showing characteristic lobular appearance.

Fig. 16.

Diffuse lipoma of the neck (Morrant Baker).

up in folds from the growth. It sometimes happens that a lipoma stretches its moorings and travels under the skin to some distant point. In the substance of the capsule as well as in the partition-walls blood-vessels ramify. The vessels are derived from an artery in the immediate vicinity. This anatomical arrangement gives to the tumor a pedunculated form, although in certain localities the tumor is sessile. From the vascular capsule and partition-walls the blood enters the centre of the growth itself. The stroma is susceptible to myxomatous degeneration, and occasionally lime salts are found in the tumor. The myxomatous degeneration of the stroma often precedes sarcomatous degeneration. The varieties of lipomata are named according to their anatomical situation. A *subcutaneous* lipoma is situated just beneath the skin in the panniculus adiposus covering the neck or the trunk, especially over the back of the shoulder (Fig. 17), or upon the sides or front of the abdomen, or on the buttocks or thigh. In these places there is a layer of normal fatty tissue. Grosch in a collection of 716 cases found the neck, back, thigh, forearm, the palmar surface of the hand and foot affected in frequency in the order mentioned. If the tumor has not been inflamed, it will usually glide freely under the skin. The lipoma

Fig. 17.

Circumscribed lipoma of the back.

in these situations varies in size from a few ounces to a few pounds. The average weight is about twenty ounces, although there are cases reported where a lipoma has even reached the enormous weight of one hundred pounds. Lipomata are occasionally observed upon the foot or upon the fingers, and also upon the palm of the hand, where they have their origin from the fatty tissue adjacent to the lumbricales muscles. Tuberculosis of the sheath of the tendons and neuroma of the plexiform variety may simulate a lipoma. The absence of pain is a marked diagnostic sign in lipoma. Lipomata are seldom seen upon the scalp or face. They are often pedunculated, and the pedicle is sometimes twisted; which anatomical fact explains in many cases their slow growth from lack of blood-supply.

The subcutaneous lipoma shows a tendency to grow upon parts that are hairless and where there is a scanty supply of sweat- and sebaceous glands.

A *submucous* lipoma takes its origin from fat underlying a mucous membrane. These lipomata have been observed in the stomach and in the intestine, where they have encroached upon the interior of the lumen of the bowel to such an extent as to cause mechanical obstruction. In one case mentioned by Mr. Pepper the lipoma was situated beneath the tongue, and it was as large as a Tangerine orange, and caused the tongue to protrude for two inches. Lipomata may be found in the larynx or behind the conjunctiva.

FIG. 18.

Lipoma arborescens of the shoulder (Sutton).

A *subsynovial* lipoma consists of a growth of normal fat which is digital in shape, projects into the joint, and is covered by the synovial membrane (Fig. 18). This condition is often observed in connection with arthritis deformans.

A *subserous* lipoma has its origin from the layer of fat beneath the peritoneum. These lipomata are found in the inguinal and femoral canals, between the folds of the broad ligament, behind the transverse colon, and in the appendices epiploicæ. They are also found in the abdominal wall apart from the rings, and develop from the subperitoneal fat which has protruded through a split in the parietes, and may drag a portion of peritoneum with it. This fact should be borne in mind during an operation, since what appears to be a simple subcutaneous lipoma may have a peritoneal attachment, in which case it is obvious the peritoneal cavity might be inadvertently opened. Lipomata situated in the peritoneal cavity require great care in their removal, since peritonitis is likely to develop in consequence of the laparotomy. The most strict antisepsis should be observed.

A *periosteal* lipoma takes its origin from the periosteum covering bones such as the vertebræ, the pelvis, and those of the lower extremity. In these tumors striated muscle-fibre has been found.

An *intermuscular* lipoma is found between muscles, as its name implies. Cases of lipoma are observed between the planes of the abdominal and thoracic muscles, between the muscles of the tongue, and also of the uterus. A case of intermuscular lipoma has occurred in the practice of Dr. Francis H. Markoe, who has kindly furnished me with a photograph of the tumor. The lipoma grew for eight years in the ilio-costal space, but during the past two years quite rapidly. The tumor, which weighed three pounds, was situated between the external and internal oblique tissue to the apex of the eleventh rib (Fig. 19).

FIG. 19.

Intermuscular lipoma (Francis H. Markoe).

In this connection may be mentioned the lipoma which is often seen in the infant and which is situated between the masseter and the buccinator muscles. The term "sucking cushion" has been applied to this growth, since it is supposed to have some mechanical action in preventing the buccinator muscles from becoming protruded between the alveolar arches during the act of nursing. The writer has seen recently one of these cases. The tumor was of sufficient size to cause a considerable deformity.

A *meningeal* lipoma takes its origin from the fatty tissues in connection with the loose connective tissue within the dura mater or from the same tissue outside of the meninges. The tumor may perforate the skull and present externally—a fact which should be borne in mind in attempts to remove the tumor (Fig. 20).

The **prognosis** in simple uncomplicated lipoma is always favorable. When it is mixed with any of the other varieties of connective-tissue tumors the prognosis is not so favorable, since under these circumstances a lipoma may become malignant. The simple lipoma may grow to an

enormous size and cause trouble from its own weight, or destroy function by pressure on the neighboring viscera or organs, or establish an inflammation which may become purulent. Occasionally a lipoma undergoes

FIG. 20.

Meningeal lipoma overlying the sac of a spina bifida (Museum, Royal College of Surgeons).

liquefaction, or it may even suppurate or the fibrous trabeculæ within the capsule may become calcareous.

The **treatment** in the circumscribed variety consists in entire excision by dissecting out the tumor with its capsule. The elliptical incision is the best in good-sized lipomata, since the flaps thus formed afford a covering for the extensive wound. The tumor should be fully exposed, after which a ligature should be placed around the pedicle formed by the entrance of blood-vessels into the capsule and tumor. The bands of connective tissue should be divided with scissors and all unnecessary tearing avoided, since the bed of the tumor forms a favorable nidus for septic infection.

In the diffuse variety with no special capsule excision is contraindicated, since the ablation of a layer of fat is apt to be followed by serious wound-complication. Brodie in these cases has suggested the administration of liquor potassæ, a remedy from which little can be expected.

Osteoma (ὀστέον, bone) is a benign tumor consisting of bone. This tumor must not be confounded with exostosis, which is an ossification of the attachments of tendons and muscles, such as are seen in the insertion of the adductor magnus, the psoas and iliacus, and the deltoid.

An osteoma is generally situated at the union of the epiphysis with the diaphysis, or, if it involve the flat bones, at those places where cartilage is present. Osteoma may occasionally develop from the periosteum without any intermediate formation of cartilage. The writer observed a

typical specimen of this variety in the Hunterian Museum. The osteoma was attached to the lower jaw.

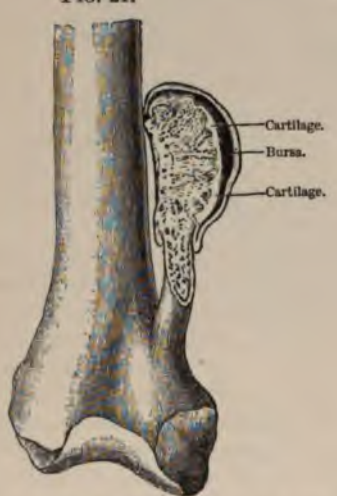
The osteoma must not be mistaken for sclerosis of bone, which is hypertrophy of bone incident to some special cause of irritation.

Osteoma may be of two varieties, the compact and the cancellated. The compact osteoma is bone-tissue resembling true bone with the exception of the absence of Haversian canals and with the lacunæ arranged in lines parallel to the surface of the tumor. It is found chiefly upon the skull, notably upon the inner surface, in the diploë, in the frontal sinus, in the external auditory canal, upon the face, also upon the periosteum of the long bones, and upon the digits. In the external auditory canal the osteoma is usually as hard as stone, hence the term osteoma durum or eburneum.

The cancellated osteoma is bone-tissue resembling cancellous bone. This variety of osteoma is usually found upon the end of the diaphysis near the epiphyseal line (Fig. 21). To this variety the term osteoma spongiosum has been applied.

Osteomata grow, as a rule, very slowly,

FIG. 21.



Exostosis of the femur: its surface was clad with cartilage and surmounted by a bursa (Orlow).

FIG. 22.

Pedunculated spongy exostosis from the lower end of the femur (Pean).

and at no time attain any great magnitude. The osteoma is hard to the sense of touch, and it is not movable under the skin, but fixed with a broad base to the bone. The tumor is never painful.

Osteoma has a favorable **prognosis**, since the tumor has no tendency to degenerate into a sarcoma, to produce metastasis, or to undergo suppuration. The slow growth and the absence of pain serve to distinguish osteoma from inflammation of bone.

The subject of osteoma ought not to be dismissed without a reference to a form of bony tumor known as exostosis or enostosis, and to calcification (Fig. 22).

Exostoses are found upon the long bones at those places where the muscles are attached to the bone, as in the linea aspera. Exostosis is sometimes observed growing from the adductor tubercle and also upon the tubercle of the first rib. It occasionally happens that inflammatory exudations undergo ossification, and certain muscles, notably the adductor longus, often become ossified, and this condition has been termed "rider's bone," since it is found chiefly among cavalrymen. Osteoma has also been observed starting from the callus of a fracture, notably the ribs. The tumor originates in the osteoblasts caused by the fracture. This condition must not be confounded with exuberant callus, which has a tendency to disappear in time. Osteoma might be mistaken for a sarcoma under these circumstances, but the clinical history will speedily reveal the true nature of the growth.

Occasionally a small osteoma is observed under the nail of the large toe. The tumor grows from the margin of the last phalanx, and pushes the nail upward and causes ulceration of the skin. Birch-Hirschfeld considers this growth as one of periosteal origin.

By enostosis is meant a bony deposit in hyaline cartilage. The tumor takes its origin from the interior of the bone.

The **treatment** of osteoma is simple, since it consists of non-interference unless some special indication is present. As the tumor is benign, if uncomplicated the surgeon ought not to undertake its removal, since serious accidents have resulted on account of opening into a neighbor joint or of exposing the interior of a bursa which communicated with a joint. Septic inflammation of bone has followed attempts to excise osteomata. If an osteoma presses upon a nerve and causes great pain, an operation is justifiable. A sharp chisel or a saw is the best instrument to use in the removal of an osteoma. In case of subungual osteoma the nail should be removed with the osteoma.

Odontoma (ὀδούς, tooth) is a tumor consisting of dental structure. To Sutton the profession is indebted for a more concise description of this as well as other varieties of tumor. The classification by Sutton is used because it is the best, and the writer is indebted to this surgeon for an account of these dental tumors which is given in his excellent work. The tumor takes its origin from a tooth-germ; the part from which the odontoma springs influences its variety. If the tumor arises from the enamel, it is termed an epithelial odontoma; if from the fibrous tissue, a fibrous odontoma; if from the tooth-follicle, a follicular odontoma; if from the tooth-cement, a cementoma; if from the crown of the tooth, a radicular odontoma; if from all the tooth-structure, it is termed composite odontoma.

The *epithelial odontoma* usually occurs about the twentieth year, and is generally found in connection with the horizontal portion of the inferior maxilla.

The tumor is enclosed in a capsule, within which are multiple and diminutive cysts varying in size and shape and containing a coffee-colored mucoid fluid. The histological structure consists of columns of epithelium which divide and subdivide, and in some cases branches of one column are engrafted upon that of another. If ulceration occurs in the mucous membrane, the appearance is very similar to epithelioma, for which it must not be mistaken.

The *fibrous odontoma* consists of a tooth contained in its sac, which has become so thickened by the deposit of fibrous tissue that it will not permit the escape of the tooth. In consequence of this environment the development of the tooth is arrested. In the meshes of the fibrous sac chalky concretions are often deposited. This variety of odontoma may be situated in the ramus of the jaw, or in the maxillary portion and project into the antrum, especially in children at the time of the eruption of the second teeth. In one case observed by the writer the tumor was only the size of a cherry-stone, and after excision has never shown any tendency to return, which, it is important to remember, is a characteristic of this neoplasm. In another case the tooth was placed upon its side and was surrounded by a capsule, and projected from the anterior wall of the antrum.

The *follicular odontoma* is a tumor occurring between the tenth and twentieth years, and is formed by the union of several denticles. The capsules connect with each other and ossification occurs in the membrane. Thus the union of several denticles forms a compound follicular odontoma, and when one tooth alone is involved a simple follicular odontoma is developed. The latter may involve the permanent teeth, notably the molars. If the wall of the cyst is very attenuated, egg-shell crepitation may be present. The cyst contains the tooth surrounded by a viscid fluid. The tooth may be found in its proper position or may be turned upon its side or inverted. The cysts may be bilateral or they may be multiple. The surgeon should examine to see if the tooth has appeared, as its absence points to the diagnosis of a follicular odontoma, since this variety can only exist in connection with the non-appearance of a tooth or teeth.

Cementoma is a tumor composed of a tooth which is lodged in a hard substance like cementum and surrounded by a capsule, which is not only enlarged, but very much thickened, by the increase of fibrous tissue. A *radicular odontoma* is a tumor composed of dentine and cementum, and grows from the roots of the tooth, since in the process of evolution the crown of the tooth is already formed. The *composite odontoma* is composed of the different structures which enter into the formation of a tooth. Usually several tooth-germs are united so as to form an irregular mass which bears but little resemblance to a human tooth. The tumor is situated in about two-thirds of the cases in the ramus of the jaw, and in the other third in the maxilla. If it springs from the upper jaw, it may invade the antrum and produce a most unsightly appearance.

The **treatment** of all forms of odontomata consists of exsection of that part of the maxilla in which the tumor is situated. The technique for operations of this kind is discussed in the special article on operative surgery. Chloroform is the preferable anæsthetic, because it may be necessary to use a Paquelin cautery, and if ether is employed a fatal explosion may occur. In small tumors ether can be administered and the operation performed quickly. A tracheotomy-tube should be in readiness in case of emergency. The writer has found that by freezing the gum with chloride of ethyl the small dentigerous cysts can be excised with but little if any pain. The surrounding gum and mucous membrane should be protected during the freezing process.

Fibroma (*fibra*, fibre) is a tumor composed of fibrous tissue. Sir James Paget suggested the term *inoma* in preference to *fibroma*, since it is more exact. Recently a distinction has been made between inoma proper and other tumors, such as fibro-myoma, uterine fibroids, recurring fibroid tumors, or spindle-celled sarcoma.

Inoma (ἴς, fibre) proper is rather a rare disease when these limitations are made. The tumor consists of bundles of fibrous tissue with long and slender fusiform cells intimately connected. The fibres are loosely or closely packed according to their variety. Fibroma finds its type in connective tissue, and the tumor is found in all parts of the body in which its prototype, fibrous tissue, is found.

Inoma appears under two varieties, the soft and the hard. The hard is chiefly observed growing from the periosteum of the jaw, from the nasal and other bones; also from the vertebræ, from the fascia, and from the sheaths of the nerves; also from the interstitial tissue of organs, as the breast, kidney, even spleen and ovaries. The hard fibroma is composed of bundles of fibres which are closely held together, and between these bundles connective-tissue corpuscles are imbedded. In true sarcoma the cells are found in rich profusion with but few bundles of fibres, and in this variation of the relation of the cells to the fibres inoma is distinguished from sarcoma.

The soft variety of inoma is found in the tissues beneath the skin and mucous membrane, and also in the intermuscular tissues. Inoma of this variety is found in the thigh and arm, and also in the loose connective tissue of the genital and anal regions.

This tumor may undergo suppuration and gangrenous degeneration, or cysts may form between the bundles of fibrous tissue, and these cysts contain fluid. The tumor sometimes becomes adherent to the integument and causes the skin to slough, and from the base of the ulcer a fungous growth makes its appearance to which the term fungus hæmatodes has been given.

Fibroma has a tendency to myxomatous degeneration caused by œdema of the intercellular spaces. The tumor also undergoes cystic degeneration in consequence of the softening. Besides myxomatous and cystic degeneration, calcareous degeneration may also occur, and then chalky deposits are found upon the periphery of the tumor or else in the substance of the growth.

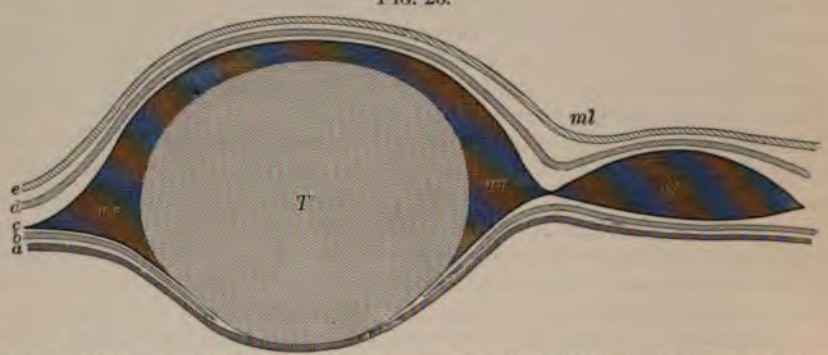
Fibroma is a slow-growing, painless tumor affecting persons under forty-five years of age, and attains only a moderate size. The tumor has a smooth surface and is surrounded by a capsule. Fibroma pushes aside adjoining tissues, and does not infiltrate like a gumma. It, however, causes atrophy of bone and impairment of function of parts in which it is found.

Fibroma may be transformed into sarcoma, which fact gives to this tumor a clinical significance. Virchow has said that "a fibroma only needs an increase in the size of its cells and a diminution of its cement-substance to change it into a sarcoma."

Fibroid tumors are sometimes found in the abdominal wall. Dr. E. J. Ill has called attention to this subject in a most interesting monograph, in which he points out the fact that these fibroids in the abdominal wall, with but few exceptions, have their origin in the sheath of the

rectus or other muscle, and that they never lie loosely between the muscles. They grow outward and cause atrophy of the muscle and fat, but rarely cause ulceration of the skin. They also grow inward into the abdominal cavity, and in doing so they may extend to the subperitoneal cellular tissue (Fig. 23), or even become adherent to the peri-

FIG. 23.



Fibroma of abdominal wall: *a*, peritoneum; *b*, subperitoneal cellular tissue; *c*, external and internal layer of deep abdominal fascia; *d*, superficial fascia; *e*, skin; *rr*, right rectus muscle; *lr*, left rectus muscle; *ml*, median line; *T*, tumor (Ill).

toneum itself. In fibroma of the abdominal wall the tumor may even rupture the peritoneum and grow into the peritoneal cavity. Laterally the fibroma may appropriate the muscles, and also be attached above to the cartilage of the ribs and below to the pelvis. The weight of a fibroma situated in the abdominal parietes varies from a few ounces to several pounds. Weir reported one case in which the fibroma weighed eleven pounds. The tumor is generally oval in form, and is usually not very vascular, although its removal may be attended by considerable hemorrhage, since the growth is fed by the deep and superficial epigastrics and internal mammary and lumbar arteries. Over 80 per cent. of the cases of intra-abdominal fibroma occur in females.

The fibroid situated in the abdominal parietes may occasionally undergo mucoid or colloid, but never fatty or calcareous, degeneration. Park has reported a case in which ulceration and fatal hemorrhage occurred.

The tumor has no tendency to disseminate or to form gland-infiltration, although it may be recurrent after removal.

The signs of a fibroma situated in the abdominal walls are the presence of a tumor, the situation of which destroys the natural symmetry of the abdomen; also a tumor which during the respiratory act is raised upward and then sinks backward while the patient is in the recumbent position, or, in other words, the abdominal walls do not separate from the tumor upon deep inspiration, as is the case in intra-abdominal tumors; among other signs are the presence of a smooth, circumscribed tumor or a nodulated growth with occasionally a point of fluctuation; a tumor which is movable whether the muscles are contracted or not, since the growth if situated in the anterior part of the abdominal wall is raised, and if in the posterior part of the abdominal wall it is depressed, whereas this is not the case if the tumor is intraperitoneal.

The differential diagnosis between a fibroma in the abdominal wall and an enlarged spleen is the presence of tympanites between the tumor and the spleen. The same physical sign is also present in differentiating fibroma from an enlarged left lobe of the liver.

A movable kidney must not be mistaken for an intra-abdominal fibroma. The size and form of the kidney, its absence from its natural place, and the resonance over the normal kidney area would serve to distinguish it from the fibroma.

Too much importance cannot be attached to the sense of touch in establishing a differential diagnosis between a fatty tumor or a cyst and fibroma, since the fatty tumor is soft and lobulated and the cyst fluctuating, while the fibroma is hard, firm, and circumscribed, and with, occasionally, a nodulated feel upon the posterior surface of the tumor.

The **treatment** of fibroma in this situation is excision of the growth. The tumor should be extirpated, if possible, without opening the peritoneal cavity; but if it becomes necessary to excise a portion of the peritoneum in order to excise the growth, this step should be taken,

FIG. 24.

Fibroma of an ear-lobule.

as half removal of the growth would be attended with more serious effects than excision of a portion of the peritoneum. The secondary effects of an incomplete operation would be most likely to terminate fatally, as the tumor would soon return.

Keloid (*κηλίς*, a scar, and *εἶδος*, resemblance) is a variety of inoma.

In 1814, Alibert first gave a full description of this tumor. This form of fibroma is vascular, and contains connective-tissue lacunæ lined with endothelial cells. The growth affects the cutis vera, and may originate without any assignable cause or develop in a scar following a surgical operation, or even upon a tubercular ulcer.

This form of inoma presents itself under two varieties, the true and the false keloid. The former is seen in new formation independent of any recognized surgical wound. The growth appears as a glistening, smooth, elevated surface with a bright pink color, which disappears on pressure. It spreads a few inches and sends out antennæ or processes with no points of ulceration. This variety is usually seen upon the front of the chest. It is also found affecting the face or the skin over the sternum, and sends out processes between the ribs. It is not generally attended by any pain, although a disagreeable sense of itching is often present. The growth develops slowly, often occupying years before any appreciable size is attained. It is found among adults as a rule, and is seldom observed in children or in elderly people.

FIG. 25.

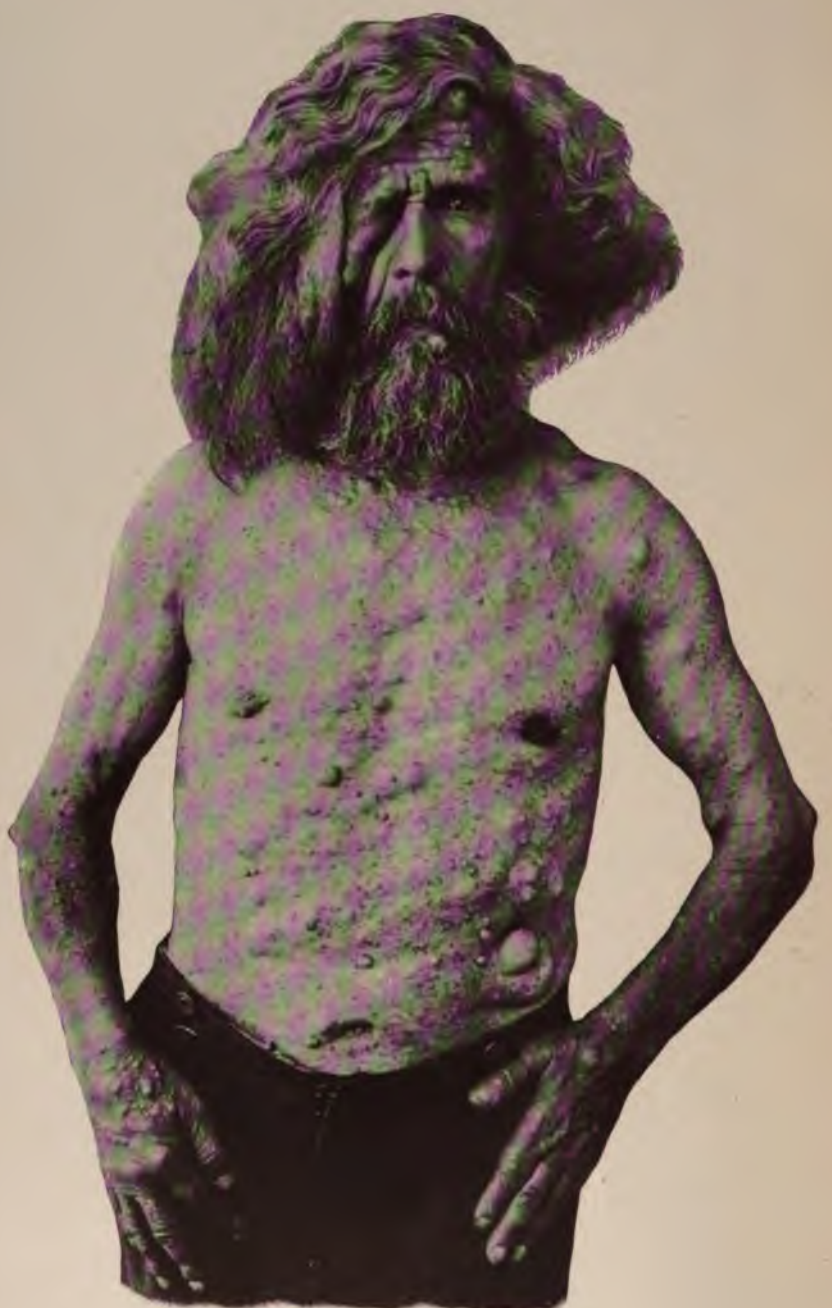
Keloid resulting from burn.

The presence of a minute scar is generally believed by modern pathologists to be the starting-point of the true keloid, although the microscopical evidence may not be visible. This variety is frequently observed among negroes, especially women, and follows puncture of the lobule of the ear (Fig. 24). It has even been observed in the scar following variola, and also after vaccination in leech-bites and in skin diseases attended by the formation of vesicles, and in syphilitic lesions. Keloid has been observed in slaves in places where the lash has broken the skin. It is also seen in negroes after stings of insects or following any slight abrasion of the skin. It has been known to grow after a blister, but especially after burns (Fig. 25).

The true keloid of Addison is hardly to be considered as a tumor, but rather an area of skin in which the muscles, fascia, and integument are intimately adherent.

The false keloid is an excess of scar-tissue. It is also seen most frequently in the African race, but this variety of keloid may develop after any surgical wound, as in the scar after amputation of the breast. For this reason the scar after any surgical operation should be left as free and unrestrained as possible, since a tight cicatrix is especially liable to develop false keloid. Langenbeck used to recommend extension of the arm at a right angle from the body during the repair of the wound after excision of the breast, since in this position a tight cicatrix is avoided. The writer has seen keloid develop in the cicatrix after

PLATE I.



Neuro-fibroma of Skin.

removal of the breast for hypertrophy. The keloid may under exceptional circumstances develop into a true sarcoma.

The **treatment** of true keloid is by excision, provided the entire growth can be removed; otherwise the disease will rapidly return, and even in cases where apparently the whole growth can be taken away there is a great tendency for a recurrence of the tumor.

In the *false* variety operation is more successful, and in order to obtain a good result the entire cicatrix should be freely dissected away and the new fresh edges of the wound brought together without any tension. If the parts cannot be approximated without tension, it is better to perform the operation of skin-grafting according to Thiersch's method. There is a tendency for tense scar-tissue to undergo degeneration, and therefore in all tight cicatrices it is best to remove them to avoid the occurrence of epithelioma that may have its origin in this poorly-nourished scar-tissue.

Recurrences after removal of a keloid are not uncommon. The incision should be carried well beyond the keloid in good healthy skin, and flaps dissected up so as to bring the parts together to heal by primary intention, and the resulting cicatrix should be protected from friction for a long period of time after the operation.

Fibroma molluscum (*mollis*, pliable) is a tumor composed of an outgrowth of the fibrous tissue of the skin. Dermatolysis, fibro-cellular tumor, and pachydermocele of the subcutaneous tissue are also terms used to designate this tumor.

The growth may appear in small nodules scattered over the entire body, or it may involve small portions of the scalp and then hang from the head in pendulous folds or be disseminated in patches over the trunk or the limbs. The writer has seen the three different varieties in the same individual. The disease has no special predilection for either sex or for any particular nationality. (Plate I.)

Virchow and V. Recklinghausen have directed attention to the fact that these tumors may grow from the fibrous sheaths of the nerves and from sweat-ducts and hair-follicles. From these facts pathologists regard these growths as neuro-fibromata. They affect the cutaneous surface, and appear as small nodules with an occasional large one (Fig. 26).

FIG. 26.

Neuro-fibroma of the radial nerve at the wrist, from a female nineteen years old. It simulated a ganglion (Sutton).

The disease has been incorrectly called elephantiasis of the skin, but the absence of the filaria in the blood flowing through the tumor indicates that the affection is not the same.

The **treatment** of this tumor is by excision. Formerly it was believed unsafe to attempt their removal, on account of an erysipelatous inflammation which often developed and caused death. This complication can be avoided by the application of the principles of antiseptic surgery, since in pre-antiseptic days infection was common from want of surgical cleanliness.

The danger of hemorrhage must be considered, as the hypertrophied masses have large vessels, especially veins, imbedded in their structure.

Chondroma (*χόνδρος*, cartilage) is a tumor composed of cartilage. It is not the result of proliferation of mature cartilage-cells, but usually proceeds from the development of tissue derived from the undeveloped or wandering cartilaginous cells. Virchow has pointed out the interesting clinical fact that chondroma affecting the femur takes its origin from remnants derived from embryonal life and found in the medulla of the bone.

Virchow has divided chondromata into two varieties: exchondroma, which springs from true cartilage or bone, and enchondroma, which is composed of cartilage developed out of connective tissue.

The *exchondroma* grows from the cartilage of the larynx, thyroid cartilage, tracheal rings, intervertebral substance, from the epiphyseal and articular cartilage of bone, from the costal cartilage, from the synovial membrane and periosteum, and also from the synchondroses. This variety is encapsulated, grows very slowly, and is attended by no pain. Frequently the exchondroma undergoes mucous softening in the intercellular substance, and the cells become fatty, in consequence of which cysts are formed. This clinical fact serves to differentiate the exchondroma from osteoma. This variety is often seen in rickety children, and Virchow has pointed out the fact that the tumor owes its origin to the existence of undeveloped pieces of cartilage which form the tumor-germ. In the bones of children affected with rickets the hollowed-out cavities are plainly visible. The exchondroma usually is solitary, but occasionally it is observed as a multiple affection (Fig. 27).

FIG. 27.

Lad twenty years of age with multiple chondromata (Steudel).

The exchondroma often becomes detached from the articular cartilage, and separates from the base and emerges into the joint-cavity, and forms what is called the "loose cartilage." The exchondroma may also be torn away from a fringe of the synovial membrane or from the periosteum and wander into the joint. The presence of these loose cartilages sets up irritation and effusion follows. The loose piece of cartilage is held in some articular pouch in the joint, or else it gets between the articular surfaces, giving rise to sudden and excruciating pain.

Enchondroma is composed of hyaline cartilage. Fibrillated connective tissue penetrates the mass in striæ or bundles, and imbedded in this are the nutrient blood-vessels. The tumor is surrounded by a capsule, is firm in consistence, and often presents a knobbed appearance. The tumor is hard, dense, and sharply defined, and springs very often from the periosteum of the phalanges, notably of the fingers.

The enchondroma may undergo ossification, especially in the breast, parotid gland, and testicle, and also in the periosteum. The tumor is often called the osteoid chondroma. In rare instances the tumor may undergo mucous softening which gives rise to a cystic formation, or it may also undergo calcification, but seldom, if ever, ossifies. And in rare cases the chondroma may be transformed into a sarcoma.

The pelvic enchondroma springs from the sacro-iliac synchondroses or from the pubic symphysis. It may be sufficiently large to cause pressure upon the viscera and render parturition difficult.

Metastases which appear in the form of emboli occur in the lungs, and in some rare instances in the heart itself. Traumatism has been assigned as the cause of enchondroma, and Weber has shown that in 50 per cent. of the cases this has been proved by statistics. Rachitis is found also to act as an exciting cause, and the young seem especially prone to it. This tumor grows very slowly, and may exist over fifty years without giving rise to trouble. Akidopeirasty can be employed as a means of differential diagnosis between the tumor and osteoma, the needle entering with a certain characteristic resistance in chondroma, while it will not penetrate an osteoma.

The **treatment** of chondroma consists of removal of the tumor if it takes its origin from the periosteum or bone; orchidectomy if situated in the testicle; and amputation of the breast if in the mammary gland. If it invades the parotid, the tumor must be excised. If it involves the phalanx, amputation of the finger is indicated if the function of the part is impaired, since any attempt at excision fails to remove the entire mass and rigidity of the tendons follows. If the chondroma affects the pelvis, operative interference is rarely indicated. The removal of the loose cartilage from the joint, notably the knee, is indicated, provided pain and inconvenience are present, but the strictest antiseptic measures must be employed. The cartilage should be located before operating, and the joint kept immovable in plaster for at least two weeks after the operation. At the time of the sudden pain the loose piece should be fixed with a clean antiseptic needle, and the operation performed without delay before the cartilage slips away from its temporary lodgement.

Neuroglioma (*νεῦρον*, nerve, and *γλοία*, glue) is a tumor which grows from the neuroglia which holds together the fibres and cells of the central nervous system. The neuroglioma takes its origin from the cells of the neuroglia. The relation between the cells and the fibrous tissue is subject to wide variation, while the vascular supply is usually very constant and abundant.

Neuroglioma is divided into the hard, soft, and vascular. The hard neuroglioma is composed of a rich abundance of fibrillæ, while the soft is composed of less fibrillæ with plexuses of blood-vessels.

The **treatment** consists of excision of the entire mass—an operation which, owing to antisepsis, has been rendered possible.

Myxoma (*μύξα*, mucus) is a tumor which consists of mucous tissue, the perfect type of which is seen in the umbilical cord. The tumor is composed of a tissue which is embryonic and found in the vitreous humor of the eye, and resembles the Whartonian jelly, which in the embryo is identical with young connective tissue. It is of frequent occurrence to find myxoma associated with the stroma of malignant tumors. A pure myxoma is of rare occurrence.

A myxoma is a benign tumor, but when it is associated with another tumor it may become malignant. It is a very slow-growing tumor, as it is non-vascular and possesses a soft consistence. It is smooth to the feel, but elastic, and usually is freely movable. There is no pain in a myxoma unless a nerve is included in the growth. A myxoma affects the skin, and it may be a pedunculated or a sessile growth. If a myxoma is cut into, its surface is very similar to a mass of jelly, and from its interior exudes a serous-like discharge.

Myxoma is found in the nasal and aural cavities, and when situated in these localities the term "polypus" has been assigned to the growth. In the nose the myxoma springs from the mucous membrane covering the turbinated bones or from the antrum or from the frontal sinus. Myxoma is also observed growing from the mucous membrane of the tympanum, and often causes deafness.

Myxoma may be a congenital or an acquired tumor. The writer has seen this tumor occur in cases in which sarcoma has existed. In one patient there was a sarcoma of the axilla and several myxomata in the inguinal region. Irritation leading to a chronic inflammation seems to act as an exciting cause in many cases, examples of which are seen in polypoid growths of the nose and ear in patients in whom a chronic catarrh or an otitis has existed for a long period.

The **treatment** consists of excision if the tumor affects the skin, or removal by avulsion if found in the nasal, aural, or pharyngeal cavities by specially constructed forceps. Early and thorough removal is necessary, owing to the danger of transition of this tumor into sarcoma. The use of caustics as a means of removal instead of the knife is interdicted. The base of the myxoma should be freely removed, since any minute particle of the tumor left may be the starting-point of a sarcoma. If avulsion is employed in the case of a mucous polypus and the base is inaccessible to free excision, Paquelin's cautery may be applied in order to destroy every vestige of the tumor. If the myxoma is found in the intermuscular spaces, the offshoot must be thoroughly removed, as the danger of malignant metamorphosis is very imminent.

Papilloma (*papilla*, meaning a teat) is a tumor composed of loops of blood-vessels supported by an axis of fibrillated connective tissue, and is found upon the skin or mucous membrane. The tumor is generally infiltrated with small round cells, and is situated in the papillæ of the skin and villi of the mucous membrane. The growth contains vascular connective tissue and is covered over with epithelial cells. In some cases the epithelial cells are pigmented. In papilloma affecting the mucous surfaces the vascular supply is very abundant. Each villus is covered over with epithelial cells, and occasionally the villi become merged into one mass, and over the whole area flattened epithelial cells are superim-

posed. Papilloma, like inoma, is divided into two separate groups, the hard and the soft papilloma. The hard papilloma is situated upon the integument and mucous membrane. A typical illustration of the hard papilloma is seen in ordinary warts upon the skin. In a large wart there are grouped several papillomata, and over the mass epithelial cells are spread.

The venereal wart or condyloma is another illustration of papilloma. The mucous membrane is also the site of papilloma, and this growth is seen upon the lips and in the mouth, in the bladder and rectum, in the vagina, larynx, urethra, cervix uteri, and nasal cavity. These papillomata often are very vascular, and the network of capillaries is supplied with ampullæ from which often extensive hemorrhage arises. There is a variety of papilloma that grows from the skin and has the appearance of a horn. The writer has removed these horns from the sole of the foot and from other parts of the body. He has also seen a large papilloma with horny scales grow from the back of the hand upon an ulcer following a burn. A typical illustration of a horn growing from the forehead of a woman is shown in the section on Tumors of the Head in the second volume.

The soft papillomata are found chiefly in the stomach and intestines, especially in the colon and duodenum (Birch-Hirschfeld), where they are covered with columnar epithelium. They are also found in the uterine cavity and upon the tongue, and within the pelvis of the kidney. They are also observed at the base of the brain and are covered over with endothelium. They are also found growing from the dura mater, and, according to Klebs, from the venous sinus. For a description of papilloma of the larynx the reader is referred to the article on the Surgery of the Larynx.

Papilloma is found at any period of life, and more frequently among females. The tumor may be pedunculated or sessile, solitary or multiple.

The special clinical characteristics of papilloma are its tendency to bleed and to undergo malignant degeneration.

Papillomata may appear in the form of psammoma (*ψάμμος*, sand), which is a tumor composed of connective tissue which has undergone hyaline degeneration and subsequent calcification. The calcareous bodies are sometimes termed corpora chalcedonica, and are composed of ammonio-phosphate of magnesia and phosphate and carbonate of lime. It is these salts which give the tumor its hard feeling like stone. The calcareous material is the same in composition as is found in the pineal gland.

The psammoma sometimes assumes the form of an angiolithic sarcoma, because it consists of spindle cells with numerous blood-vessels. From the congeries of blood-vessels and spindle cells bud-like processes shoot out from the side of the vessels, which are surrounded also by laminæ of spindle cells. The nucleus of the bud is formed of a hard, cretaceous material like brain-sand. This variety of tumor is usually confined to the pia mater of the brain and spinal cord. A few cases, however, of psammoma have been reported in which the tumor grew from the inner surface of the dura mater.

In the brain psammoma takes its origin from the cells of the

choroid plexuses of the velum interpositum and from the roof of the fourth ventricle. If the psammoma is very small, it gives rise to no special cerebral symptoms. If large, it will cause serious mental disturbance, and if the tumor is situated in the cerebellum, there will be severe cephalalgia, blindness, ataxia, vomiting, optic neuritis, priapism, and opisthotonos, which symptoms invariably lead to death. If the psammoma is of any size and affects the spinal cord, the pressure-effects are well pronounced, among which may be mentioned, notably, ataxia and paraplegia.

These cases also invariably terminate in death unless removed by surgical interference. Virchow has described a form of papilloma which affects the matrix of the nails, to which he has assigned the term onychoma. The disease resembles the corium cutaneum form of papilloma. Irritation caused by uncleanliness seems a potent factor in the etiology of the disease, although in persons of the strictest hygienic habit the tumor is found. The nail becomes thickened, tortuous, and long, and often is curved like a ram's horn.

A tumor allied to psammoma has been described by Miller under the term "cholesteatoma," which consists of a small nodule about the size of a marble and situated in the pia mater at the base of the brain in the meninges and in the ventricles, also in the membrana tympani. The nodule is surrounded by a thin membrane, and within the capsule the fatty substances are found in laminated layers formed of fat and cholesterin crystals, and endothelial cells. The tumor is benign in that it never gives rise to metastasis.

The treatment of papilloma consists of excision. The special methods of operating are found under the regional surgery of the parts. Psammoma, as a rule, does not admit of surgical interference except in very rare instances, as the situation of the tumor is in such places as to render it inaccessible to the surgeon. In onychoma besides avulsion of the nail the matrix should be freely excised and the bed cauterized.

Sarcoma (σάρξ, flesh) is a disease the study of which is fraught with great interest. It is a subject of great importance, owing to the terrible mortality which attends the affection. Sarcoma usually terminates in death, and its early recognition and its complete removal are subjects which are worthy the profound study of the surgeon. Sarcoma, in the large majority of cases, is a disease more deadly in its nature than any other variety of malignant tumor. Its unprecedented rapidity of growth, its widespread metastases, its insidious development, its uncertainty of early diagnosis, its absolute certainty to kill, make it a subject of paramount importance. The appalling impressions which the writer has received from a large clinical experience with this dreadful malady leads him to regard this neoplasm as one to which the attention of the thoughtful surgeon should be assiduously directed.

In studying the subject a number of important questions present themselves for consideration. It is by accumulative investigation and by comparison that the surgical profession can acquire knowledge upon matters relating to malignant disease. The malignancy, the etiology, the clinical history, the prognosis, the diagnosis, and the treatment, besides other important subjects in regard to tumors, can only be com-

prehended by an exhaustive study of a large number of individual cases. The consideration of a typical case of sarcoma of bone, for example, affords no reliable knowledge which can be applied to another case of sarcoma of bone. This variety of malignant tumor of bone has a wide range of difference, and it is only by comparison that we can arrive at any satisfactory knowledge.

Sarcoma is a tumor of *connective-tissue* origin, consisting of cellular and embryonic elements imbedded in an intercellular matrix with blood-vessels between the cells. Sarcoma is generally malignant, but there are some varieties, of which mention will be made later, that are entitled to a place among the so-called benign growths. As a rule, however, sarcoma is a horribly and rapidly fatal disease. The scientist who discovers its cure deserves to be ranked with the discoverer of anæsthesia.

The blood-supply in sarcoma is chiefly through the capillary system. In the round-celled variety the vascular supply is very abundant, while in the spindle-celled it is meagre. This anatomical fact serves to explain the greater rapidity of growth in round-celled sarcoma. Sarcoma is of mesoblastic origin, while carcinoma, with which this tumor was formerly confounded, is of epiblastic and hypoblastic origin. Virchow in 1847 gave to sarcoma its present histological status.

If a sarcoma grows rapidly, the vessels possess very thin walls and may rupture, giving rise to repeated hemorrhages. The extravasated blood is thus circumscribed, and a cyst is formed to which the term "malignant blood-cyst" has been given.

Dissemination of sarcoma is an important characteristic. The lung, liver, kidney, and spleen are the organs most prone to become infected

FIG. 28.

Multiple metastasis following sarcoma of thigh. Amputation at hip-joint, showing cicatrix with no return at seat of operation.

secondarily from a primary growth. The special organ which is attacked by secondary deposit depends upon the situation of the initial neoplasm: if in the parts of the body associated with the general systematic circu-

lation, the lung is involved; if in connection with the portal vessels, the liver is affected. In some cases both these organs, as well as the remaining viscera and bones and tissue of every kind, may become infected. In one of two cases in which the writer performed amputation at the hip-joint for subperiosteal sarcoma of the femur the patient lived a year after the operation free from the disease, but at the expiration of that time the disease suddenly returned and in a few weeks destroyed the life of the patient (Fig. 28). Every organ and viscus and all the bones, as well as the muscles, were attacked simultaneously with sarcoma. An important clinical fact worthy of mention in connection with this case is the absence of a recurrence in the cicatrix of the stump at the seat of the original exarticulation at the hip-joint. In the large number of operations for the relief of sarcoma performed by the writer in no case has he ever seen a return of the disease in the cicatrix of the wound. This is in marked contrast to the history of carcinoma, which shows most frequently a return of the disease in the cicatrix or in the skin in and about the site of the original growth.

The manner of dissemination of sarcoma is chiefly by the blood-vessels, notably the veins, and especially those emerging from the tumor.

FIG. 29.

Cystic sarcoma of shoulder (Francis H. Markoe).

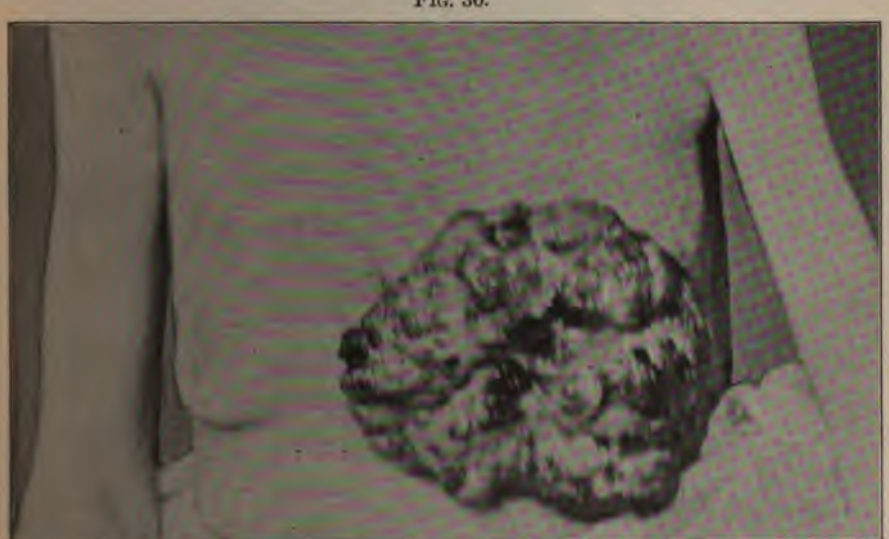
These channels convey the cells which cause the secondary deposits in certain tissues or organs. The walls of the blood-vessel are indurated, and the growth may extend even into the lumen of the vessel. The writer had one case of sarcoma of the lung—a reference to which is made in the article on Diseases of the Veins, p. 458, Fig. 377, Vol. II.—in which the sarcoma grew through the walls of the vessel into the pulmonary vein and occupied the left ventricle of the heart.

The dissemination of sarcoma is different from that of carcinoma, which is usually accomplished by the lymph-channels. Sarcoma, besides showing a great tendency to disseminate in the body, also exhibits an infiltrating tendency. This is especially true if the capsule is incomplete or has ruptured, or if the tumor has taken its origin in the sheath of a tendon, in which case the fasciculi of the muscle are destroyed and the muscle itself becomes infiltrated. In sarcoma of the pelvic bones the growth often infiltrates throughout the pelvic organs and vessels.

Sarcoma may be found in almost any structure, tissue, organ, or bone in the body. The subcutaneous tissue, fascia, periosteum, medulla of bone, and certain organs like the testicle and ovary, as well as glands, are especially prone to the development of sarcoma. The disease is primary in bone; but not, as a rule, in muscles or such organs as the lung, liver, spleen, or uterus. The alimentary canal is seldom if ever affected by sarcoma as a primary disease.

During the development of sarcoma fatty degeneration may occur in the cells. It is believed that the shrinkage of sarcoma in some rare cases is due to this retrograde change in the cells. By some the diminution in size is thought to be due to the prolonged use of arsenic or to the action of the germ of erysipelas. In addition to fatty degeneration, mucoid degeneration may occur in a sarcoma, giving rise to the formation of cysts (Fig. 29). Rupture of the thin vessels also occurs, and the malignant blood-cyst is formed to which reference has already been made.

FIG. 30.



Fungus hæmatodes (Francis H. Markoe).

Sarcoma is caused, without doubt, by traumatism, especially when its seat is in the bones. The question of the etiology of sarcoma has already been fully discussed in connection with the subject of the etiology of tumors.

The **clinical history** of sarcoma is an interesting feature of the dis-

ease. It is the malignant disease of early childhood, and has been seen in an infant under one year. As a rule, it is a tumor which develops suddenly and which runs oftentimes a rapidly fatal course. Sarcoma of bone is usually a nodular, painful, rapidly-growing neoplasm, which in the later stages begins to ulcerate (Fig. 30). If it grows from the subperiosteal tissue, it is found to affect the shaft of the bone (Fig. 31); it is not

FIG. 31.

Subperiosteal sarcoma of humerus (Wood Museum).

distinctly circumscribed, grows very rapidly, and is not associated with inflammatory processes. If the sarcoma grows from the medulla of the bone, it is termed "central sarcoma," and usually affects the extremities of the bones instead of the shaft (Fig. 32). It is a distinctly circumscribed neoplasm instead of a diffuse swelling, and grows slowly, which is in marked contrast to the subperiosteal variety. The slow growth is due to the fact that absorption of bone must take place by pressure of the tumor. This pressure causes atrophy of bone, and the process is necessarily slow. The central sarcoma has an egg-shell crepitation in the later stages of the disease. This crepitation is due to the breaking of the attenuated and fragile shell of bone which has been pushed out by the growth from within, and is a pathognomonic symptom of central sarcoma. After the central sarcoma has reached the surface of the body, having perforated the bone, the progress of the disease may be very rapid.

The malignancy of sarcoma is manifested by the widespread metastases, by its annihilation of adjoining tissue, by its pressure-effects, causing hemorrhages and ulceration by its infiltration through blood-vessels in the majority of cases, and, finally, by its rapid strides toward a fatal termination unless interrupted by a radical operation.

Sarcoma is classified according to the character of the cells of which the tumor is composed. There are spindle-celled, round-celled, and mixed-celled sarcomata, also alveolar and melanotic. Sarcoma has also been classified on a basis of the pathological changes which occur in the

FIG. 32.

Sarcoma of shoulder (Wood Museum).

intercellular substance. If fibrous tissue prevails, the term "fibro-sarcoma" is employed; if muscular tissue, "myo-sarcoma;" if neuroglia is in excess, then a "glio-sarcoma;" if sarcomatous growth occurs in a blood-vessel, the term "angio-sarcoma" is applied; if lymphatic tissue, the expression "lympho-sarcoma" is used.

This tumor is also classified according to the character of the connective-tissue substance of which the neoplasm is composed. If fibrous connective tissue is present, then a fibro-sarcoma develops; if gelatinous, a myxo-sarcoma; if fatty, a lipo-sarcoma; if cartilaginous, a chondro-sarcoma; if bony, an osteo-sarcoma, if lymphatic glandular connective tissue, a lympho-sarcoma; if vascular connective tissue, telangiectatic sarcoma.

The first classification is the better one for the practical surgeon, for upon the presence of the characteristic cells the prognosis depends.

The **diagnosis** of sarcoma in the early stages is often very difficult. The microscope only can decide, and in some cases this test is inadequate. Time, which might afford definite information, cannot be utilized for the

purpose of diagnosis. Procrastination in coming to a decision is too dangerous an agency to employ to settle such a momentous question. The use of the harpoon may throw light upon this doubtful and grave question, and under certain circumstances may settle beyond all peradventure the malignancy of the growth. In addition to the harpoon, Dr. John C. Warren has devised an instrument for the purpose of withdrawing a small piece of the tumor for microscopical examination (Fig. 33).

FIG. 33.

Dr. Warren's instrument for withdrawing a small piece of a tumor for microscopical examination.

The length of time the tumor has existed and the manner in which the tumor developed are important points to consider in the diagnosis. The sarcoma begins under the skin and grows, while a carcinoma begins upon the surface. In either case the deep structures, including bone, may be secondarily involved. In sarcoma of internal organs the temperature is said to show irregular curves, which is not the case in carcinoma before sepsis intervenes.

Great care should also be exercised in not making undue haste in coming to a conclusion as to the presence of a sarcoma. The writer has had three cases sent to him for the purpose of amputation on account of sarcoma. Each of these three cases proved to be a chronic inflammation of bone, and each was cured without amputation by free incision of the overlying soft parts, by trephining the bone to relieve tension, and by dressing the wound antiseptically. One of these cases was supposed to be sarcoma of the thigh, the other two were thought to be sarcomata of the tibia, and all three cases had consulted surgeons who pronounced the neoplasms malignant and advised amputation.

The points of differential diagnosis between sarcoma of bone on the one hand and chronic inflammation of bone on the other hand are as follows:

Sarcoma of Bone.	*Chronic Inflammation of Bone.*
1. Attacks extremities unless subperiosteal.	1. Attacks the shaft.
2. Forms soft swelling in comparison with sclerosis of bone.	2. Forms hard, smooth bone.
3. Rapid in its course.	3. Slow in its course.
4. Distended veins over the surface of tumor.	4. No distended veins over surface, as in sarcoma.
5. Does not invade joint.	5. Usually invades the neighboring joint.
6. Circumscribed areas of fluctuation over swelling, where cysts filled with bloody serum are found.	6. Diffuse areas of fluctuation, in which pus is found instead of bloody serum.

Another very important differential diagnosis must be made between sarcoma and carcinoma:

Sarcoma.	*Carcinoma.*
1. Origin of growth is from the mesoblast.	1. Origin of growth is from epiblast or hypoblast.
2. Disseminates usually by blood-vessels.	2. Disseminates usually by the lymphatic vessels.
3. Tumor generally enclosed in a capsule.	3. Tumor is never enclosed in a capsule.
4. Cachexia appears late in the history of the tumor.	4. Cachexia appears early in the history of the growth.
5. Disease found in early or middle life.	5. Disease found late in life, as a rule.
6. Not so painful a tumor as carcinoma, and may develop with little or no pain.	6. Sharp, lancinating pains, as a rule.

The **prognosis** in sarcoma is as gloomy as can be imagined. It is a disease which destroys life rapidly unless arrested by amputation. The prognosis may be modified as regards time by the situation and the particular cell-variety of the sarcoma. In whatever way we look at the prognosis, it is serious. On the other hand, a radical amputation may rescue a patient's life even in the cases of the most malignant variety.

The **treatment** of sarcoma of the long bones is simple, because there is but one operation, and that is amputation. From an experience derived from a large number of cases of sarcoma of bone, and from opinions formed after careful study of the cases of others, the writer is more and more impressed with the fact that amputation is the only operation which should be contemplated. The operation of excision or enucleation and the application of caustics are not to be recommended, because the disease is not, as a rule, radically removed by these methods, and oftentimes the tumor returns very rapidly, and the enucleation and cauterization seem only to add fuel to the fire and to hasten very materially a fatal end.

In all cases of sarcoma of the long bones amputation should be decided upon at the earliest period possible, and the operation performed without delay. This step necessitates an amputation of the lower part of the thigh in case the tibia or fibula is the seat of the neoplasm, and in addition the removal of the popliteal glands, and at the hip-joint when the tumor is subperiosteal and involves the shaft of the femur. The same rule applies to the upper extremities. In view of the great mortality of hip-joint amputation a possible exception might be made in case of a central sarcoma of the condyle of the femur which was recognized early and which was small in size. By amputation in the lower third of the femur in sarcoma of the tibia or fibula the popliteal glands are removed (Fig. 34), and while this point would concern us more if the disease were cancer, yet occasionally sarcoma affects these glands.

The remedy of amputation with such seeming sacrifice of parts seems a severe one, but the disease for which the amputation is performed is, as a rule, a fatal one if left to nature, and in view of the great malignancy of sarcoma the operation should be the most radical one consistent with a due regard for the life of the patient during the immediate performance of the operation. It must be remembered that the patient is suffering from a fatal disease, and the chances of escape from it are in proportion—within proper limits, of course—to the distance at which the limb is removed from the seat of the malignant tumor. The amputation, therefore, should remove the entire bone affected and the glands adjacent to the proximal joint.

In the treatment of sarcoma the surgeon must guard against the possibility of lawsuits. There is so much ignorance among the uneducated upon the nature of the malignancy of certain tumors, and so great a natural antipathy to amputation for the relief of these tumors, that a surgeon, in order to protect himself, should refuse in dealing with this class to have anything to do with a patient unless a distinct understanding exists. A surgeon cannot otherwise protect himself against the unprincipled lawyer who plays upon the feelings and sentiments of his clients with visions of a large sum of money for supposed malpractice.

Sarcoma of bone may be divided into central and subperiosteal according to the origin of the growth. It is, however, extremely difficult in some cases to state whether the growth had a central or peripheral origin. The chief diagnostic clinical point is the greater rapidity and malignancy of the subperiosteal variety.

THE CENTRAL ROUND-CELLED SARCOMA of bone is a smooth, egg-shaped, encapsulated tumor. The capsule is formed of a membrane of thin osseous tissue. From the inner surface of the capsule fibrous partitions are given off, so that spaces are formed within the capsule, and into these cavities hemorrhage often occurs, so that an enormous blood-

FIG. 34.

Subperiosteal sarcoma of tibia, showing amputation of entire leg with removal of popliteal glands.

FIG. 35.

Central sarcoma of upper end of tibia. Amputation of lower end of femur.

cyst is formed, and in some cases the tumor resembles an aneurysm. As the tumor extends toward the periphery the muscles often become invaded, and while the ligamentous structure of a joint may be involved the sarcoma seldom attacks the joint itself. The lymphatics may become involved, and also metastases take place in the viscera and in the walls of the blood-vessels. Fracture of the bone may ensue in consequence

of the marked atrophy of the bone. The tumor soon produces tension upon the skin and ulceration follows (Fig. 35). A fungous growth now springs up, so that a large ulcerating mass appears.

The central sarcoma of bone at first grows slowly in comparison with the subperiosteal sarcoma of the shaft. This is due to the fact that the tumor is compressed by bone, but when this barrier is broken down and the fungous stage is reached the growth is very rapid. Occasionally the tumor is very vascular, and pulsates, so that it has been mistaken for aneurysm.

The **treatment** of central sarcoma is amputation only, since the disease is of too serious a nature to attempt any operation of less severity.

Butlin describes operations for removal of central sarcoma affecting bone, by excision. Such an operation is manifestly ineffectual and does not deserve a moment's consideration. In all my cases of sarcoma of bone in which recovery dating back over three years has occurred the limb was removed, so as to include the entire bone affected. Any operation short of this radical one is sure to be followed by a return. It seems a terrible sacrifice to remove the thigh at the hip-joint for a sarcoma involving the condyles or lower third of the shaft of the thigh, or the leg above the knee-joint for a sarcoma affecting the malleolus; but the results in the writer's twenty-one cases of sarcoma of bone of the different varieties with permanent cures prove the necessity, and the cases of excision or partial amputation through the bone collected by Butlin, with a history of return in nearly every case, prove the utter uselessness of any operative measures of a less radical character.

Butlin has collected in his book 82 cases of central sarcoma treated by operation, of which 23 died from the immediate effects of the operation, which gives a mortality of 28 per cent. for the operation itself; 5 died from recurrence, and only 10 patients were known to be alive at the end of a year, and some of the 10 after two or more years.

Warren, in his book on *Surgical Pathology*, reports, from Gross, 34 cases of central sarcoma of bone, of which 3 died without operation, and of the 31 operated upon, 5 died from the immediate effects of the operation, thus giving a mortality of 16 per cent. in consequence of the operation itself; 6 cases died from recurrence, and 2 had not reached the three-year limit of time; there are therefore 18 cases still alive. Of the 31 cases operated upon, 2 had not reached the three-year limit of time, which leaves 29 cases whose subsequent histories are known. Of these, 18 were permanently cured, which gives us 62 per cent.

The writer has had only one case of central sarcoma. This patient was operated upon and recovered, and is still alive after ten years from the date of the amputation.

THE SUBPERIOSTEAL OR SPINDLE-CELLED SARCOMA of bone is composed of fusiform cells which are arranged in fasciculi or bundles and cross and interlace with each other. This peculiar arrangement of the spindle-celled sarcoma gives to it a characteristic appearance upon microscopical section. The cells are cut in their long axes in some cases, and in other cases at right angles. The cells may be either large or small, with an oval nucleus. The extremities terminate in an attenuated fibre.

THE LARGE SPINDLE-CELLED SARCOMA is less malignant than the

small-celled. The protoplasm of the spindle cell helps to form a dense stroma, while the nuclei of the cell remain visible. It is often with great difficulty that a spindle-celled sarcoma can be differentiated from the fibroma, but the presence of many large nuclei is a distinguishing feature. This form of sarcoma affects the periosteum, and soon causes a fusiform swelling about the circumference of the bone. In the spindle-celled sarcoma a few giant cells, and even round cells, are often found. In this variety of sarcoma ossification sometimes occurs on account of the formation of new bone, and to this condition the term "ossifying sarcoma" has been given. Under these circumstances the tumor is hard, while usually sarcoma is soft, nodular, and in places fluctuating, owing to the formation of cysts. The signs of a spindle-celled sarcoma are—a tumor with pain and tenderness which affects the shaft of the long bones, and one which shows great rapidity of growth and marked manifestations of regional dissemination (Fig. 36).

FIG. 36.

Subperiosteal sarcoma of femur, ten years of age (Wharton).

The *results* of treatment in the subperiosteal sarcoma admit of a wide range of variation. Butlin records 78 cases of subperiosteal sarcoma, of which in 28 cases the results were unknown, and in 6 more the patients had not reached the three-year limit of time, which leaves 44 cases in which the full subsequent histories are known. Of these, 14 died of the operation and 29 from recurrence, which leaves but 1 permanent cure in the 44 cases. There are thus 78 cases in which operation was performed, and of these 14 died from the immediate effects of the operation, which gives 18 per cent. of mortality from the operation. In the 44 cases whose subsequent histories are known there was but 1 permanent cure, or 2 per cent.

In subperiosteal round-celled sarcoma of bone Gross states that the duration of life was eighteen months, and of 6 cases operated upon, only 1 remained well without local recurrence beyond three years, thus giving about 17 per cent. of permanent cures.

The writer has had 20 cases of subperiosteal sarcoma of bone in which he has operated, 1 of which died of shock in consequence of an amputation at the hip-joint. This gives a mortality of 5 per cent. for the operation. Out of these 20 cases the results of 4 are unknown. In a summary of his remaining 16 cases of subperiosteal sarcoma in which

the full histories are known there are 3 deaths and 13 permanent cures. This gives 81 per cent. of permanent cures beyond the accepted three-year limit of time.

If the femur is involved, amputation at the hip-joint is necessary; if the tibia or fibula, amputation just above the knee, with removal of the popliteal gland, is indicated; if the radius or ulna is involved, amputation at the elbow-joint, with removal of the trochlear glands, is required; and if the humerus, amputation at the shoulder-joint, for the safety of the patient, with removal of the axillary lymphatics and others if possible, is necessary. Nothing short of these radical operations deserves consideration when the frightful mortality of incomplete operations is so familiar.

THE MIXED-CELLED SARCOMA is a tumor in which, as its name implies, there is a mixture of several varieties of cells. The round and the spindle cells are both found in the same growth. The general characters of the mixed sarcoma are very similar to those described under the round- and spindle-celled sarcoma.

THE MYELOID SARCOMA of bone is composed of a polymorphous cell, of which the giant cells are the most frequent. This variety of sarcoma takes its origin from the connective tissue of the medulla of the long bones or from the diploë of the cranial bones. It is seldom observed as a periosteal sarcoma.

The central sarcoma of the myeloid variety is found in the head of the tibia and in the shafts of the other long bones and in the maxillæ. The tumor takes its origin from the medullary cavity of the bone, and grows slowly on account of the mechanical obstruction which is offered by the bone. After a while the tumor breaks through the bone by pressure, which causes atrophy of the osseous structure. Over the entire mass a thin layer of bone is found, so that in the latter stages there is present an egg-shell crackling which is pathognomonic of central sarcoma. The central sarcoma is not usually very vascular, and for this reason is not subject to retrograde changes. Fatty degeneration is common, and also mucoid softening, which gives rise to cysts containing bloody fluid, is frequent. The tumor occurs usually between the ages of twenty and thirty, and in exceptional cases metastasis is present. The tumor gives to the skin a mahogany color.

ROUND-CELLED SARCOMA consists of numerous round cells, either small or large, with but little intercellular substance. The nuclei of the round cells are large and the protoplasm is small. Lymphatics are not present, but blood-vessels are numerous and situated between the cells. It is the fact of the absence of the walls of the vessels that explains the large blood-channels in this variety of sarcoma.

The round-celled sarcoma may affect any tissue or organ in the body: it attacks persons of all ages from earliest infancy to extreme old age. It affects chiefly the shaft of the long bones, and it is a more malignant growth than the giant-celled sarcoma. The tumor steadily and rapidly grows, since it has no bony wall to prevent its advance. The round-celled sarcoma, affecting as it does the shaft of the bone, grows from the periphery. The tumor may be somewhat nodulated, and eventually the integument becomes infected and the lymphatics involved. Metastasis is very common in the viscera. A variety of round-celled sarcoma is known as lympho-sarcoma, a tumor in which the round cells

are held in a delicate network or stroma, and the general appearance of which is similar to lymphatic tissue. Lympho-sarcoma must be differentiated from inflammatory enlargement of the lymphatic ganglia, and also lymphadenoma, for a full description of which the reader is referred to the article on the Surgery of the Lymphatic System.

ALVEOLAR SARCOMA is a tumor in which the cells lie in a stroma having an alveolar structure. The writer has seen several cases of alveolar sarcoma in pigmented moles situated upon and in the skin. The danger of leaving these upon the body is apparent when the histological construction is considered. These moles may remain quiescent for years, but, on the other hand, they may suddenly grow and give rise to a malignant neoplasm. The writer has recently seen several cases of this variety of sarcoma arise from pigmented moles.

FIG. 37.

Pigmented mole which ulcerated and infected the inguinal lymph-glands; the patient was sixty-five years of age (Sutton).

The **treatment** consists of free excision in case the tumor is situated in the skin; of amputation if the disease affects the bones of the extremity; and a most thorough radical operation if the disease affects the glands.

MELANO-SARCOMA is found in the skin in the form of pigmented moles or at the matrix of the nail or toe. The melano-sarcoma of the skin has an alveolar arrangement of the cells (Fig. 37). The mole may remain innocuous for years, and then suddenly begin to show signs of ulceration. The lymphatic nodes nearest to the mole become enlarged and discolored, and soon degenerate into a melano-sarcoma from infection. The dissemination may even become widespread, so that the bones, the liver, the lung, the kidney, the spleen, the brain, and other organs become involved. In these cases melanin is secreted by the urine, and in others a general melanosis occurs. Melanosis is also observed in connection with the digits, notably the hallux, and from this focus metastasis occurs. Melanosis is also seen in the uveal tract and in the connective tissue which surrounds the choroid, the iris, and the ciliary body.

The **treatment** is excision of the melano-sarcoma at the earliest possible date. The operation is rarely followed by permanent recovery, and only when the operation is performed early and before dissemination has occurred.

SARCOMATA AFFECTING THE GLANDS may be found in the cavities of the body as well as upon the surface. They grow rapidly and produce metastasis.

In sarcoma of the glands statistics are also very meagre. Butlin reports that he cannot discover a single case of permanent recovery after operation from the removal of sarcoma of glands. The writer has had 12 cases of sarcoma of glands, the subsequent histories of which are all known. Recovery has occurred in every case but one, thus giving $91\frac{2}{3}$ per cent. of permanent cures beyond the three-year limit. In the 11 successful and permanently cured cases of sarcoma of the glands there were some tumors which were very large. In two the tumors involved the neck, one of which was larger than a child's head, necessitating a deep and dangerous dissection which exposed the large cervical vessels. In another case the tumor was not so large, but was situated about the important vessels. In still another case the tumor was situated about the femoral artery and vein, and in still another about the popliteal vessels. Some of the tumors were removed in the presence of alarming hemorrhage and involved a most formidable operation.

Sarcoma of the mammæ is especially considered in the article on Diseases of the Breast, and sarcoma of special organs or viscera in the different articles devoted to a consideration of the surgery of the respective parts.

SARCOMA OF THE SKIN may occur either as a primary affection or as a secondary deposit. The origin of the disease is in pigmented moles, especially those in which hair grows; also from injury and from cicatricial and granulation tissue, and from warts. The disease may have its origin from the subcutaneous cellular tissue as a secondary deposit, or from the upper or lower stratum of the integument in the primary neoplasm. Weber has demonstrated that sarcoma of the skin may start from the walls of the blood and lymphatic vessels, in which case the tumor has an endothelial origin. Winiwarter has demonstrated that sarcoma may even grow from the connective-tissue structures of the integument.

Sarcoma of the skin appears in the form of an ulcer which differs from carcinoma of the skin in that in the former the ulcer forms a fungous mass which has forced its way up from below through the skin, whereas the carcinomatous ulcer begins upon the skin-surface and penetrates below the level of the skin, with an indurated base and margin. The sarcomatous ulcer of the skin is often pigmented and gives rise to what is termed melano-sarcoma, the peculiar histological feature of which consists of an alveolar arrangement of the cells, which may be either round or spindle-shaped.

The melano-sarcoma which has just been described may originate from a pigmented mole which for many years has remained dormant in the skin, but which, from some exciting cause, suddenly begins to grow. The skin-nodule becomes painful, the color of the integument changes to a black, and the adjacent lymphatics enlarge. The ulcer soon becomes inflamed and the surface bleeds. If the disease is not promptly arrested by free excision, secondary deposits appear in the viscera.

In some cases the primary melano-sarcoma fails to disseminate itself in the various internal viscera, and instead seems to generate pigment,

which, after entering the blood, gives to the skin a peculiar dusky hue, and finally the melanin is eliminated in the urine.

The treatment of melano-sarcoma of the skin consists in prompt and radical excision, including the adjacent lymphatic nodes. In this connection the question of the prophylactic removal of all pigmented hairy moles derives special emphasis.

Myoma (μῦς, muscle) is a tumor composed of muscular fibres. There are two varieties, classified according to the histological character of the fibres—the leiomyoma and the rhabdomyoma, the former representing the unstriped muscular tissue, and the latter the striped and transversely striated muscular tissue. It was originally considered as a fibroma on account of the excess of fibrous stroma, and to Virchow is due the credit of first describing this tumor as a distinct variety.

The leioma (λεῖος, smooth) consists of the involuntary smooth muscular fibres which are found in those muscles which preside over organic life. This variety of myoma is found in certain organs, as the uterus and ovary, the broad and ovarian ligaments, the prostate gland, the bladder and kidney, in the œsophageal walls, the stomach, and alimentary canal (Fig. 38), and occasionally in the cutis vera and also in the subcutaneous cellular tissue. This tumor may undergo secondary changes, such as fatty degeneration, cyst-formation by distention of the lymph-spaces, calcification, and suppuration and œdema. The œdema is caused by an obstruction of the venous circulation either by mechanical pressure or torsion of the pedicle or flexion of the growth, or by thrombosis. Under these circumstances the serum exudes into the connective-tissue space and separates the muscular striæ. The fibrous tissue is softened by the exudation. The tumor is usually encapsulated, and the cells are fusiform in shape and contain a rod-like nucleus. Hemorrhages are common if the tumor is vascular, owing to the mucoid softening which often takes place.

FIG. 38.

Myoma of the ileum projecting into the peritoneal cavity (Richardson).

If a section of leiomyoma is examined under the microscope, the muscular cells are seen in bundles which are generally parallel. Occasionally a few bundles are seen running at right angles or obliquely to each other. These variously arranged bundles are held together by connective tissue which is more or less vascular. Sometimes the fibrous tissue is very dense, and the name of fibro-myoma has been assigned to this tumor. Lymph-spaces are occasionally seen in this tumor and a few nerve-filaments. If a section is made, the microscopical appearance

shows a white glistening surface due to the presence of the fibrous tissue, and a reddish shade due to the muscular tissue itself.

(For a description of myoma of the uterus, the urinary organs, and the skin the reader is referred to the articles especially devoted to a consideration of the diseases of these special organs and tissues.)

The second variety of myoma, the rhabdomyoma (*ῥάβδος*, rod), was first described by Zenker. It is usually congenital, and is rare and consists of striated muscular fibres. The tumor is also composed of fibrillar connective tissue with spindle and spheroidal cells, so the growth appears very much like a sarcoma; in fact, this variety is generally found in conjunction with sarcoma.

The congenital rhabdomyoma is often found in the heart, kidney, testicle, and ovary; also in the voluntary muscles, notably the deltoid, biceps, and also in the muscles belonging to the lumbar region. Prudden found striped muscular fibres in the parotid gland of a boy.

The **signs** of a myoma consist of the presence of a slow-growing nodular tumor; stenosis by mechanical pressure if involving the œsophagus and intestines; hemorrhages if the tumor involves the uterus.

The **prognosis** depends upon the direction and rapidity of the growth as well as upon the situation. The prognosis is also influenced by the severity of the hemorrhages and by the extent of impairment of function of the affected organ. The presence of suppuration adds great gravity to the disease, and the possibilities of sarcoma-transformation must be considered in estimating the prognosis.

The **treatment** of myoma depends upon the situation of the growth and the special variety. In some cases only symptoms can be treated. Ergot has been recommended with but little success. It is useful as an injection to arrest bleeding in uterine myomata. Electricity has been extolled by Apostoli, but the results are not such as to commend it for universal adoption.

(For myoma affecting the uterus and its appendages the surgeon is referred to the article on Diseases of the Uterus; for the prostate gland, to that on Genito-urinary Surgery; for the alimentary canal, to that on Surgery of the Abdominal Cavity.)

In myoma affecting the voluntary muscles operative interference is demanded, since this tumor is essentially a sarcoma. Langenbeck has even suggested amputation of the arm at the shoulder-joint as the proper treatment, since any attempt at excision of the rhabdomyoma is usually followed by a quick return, attended by all the dangers of pure sarcoma.

Before an operation as serious as the one just mentioned is undertaken it should be carefully considered, as the prognosis is influenced by the character of the operative treatment. The writer saw one case involving the deltoid muscle, and amputation of the arm at the shoulder-joint was performed. This was the only operation that could be performed, though it seems a severe measure.

Angeioma (*ἀγγεῖον*, a vessel) is a tumor composed of blood-vessels. The disease is fully discussed in the article on Aneurysm and the Surgery of the Arteries and Veins.

Lymphangeioma is considered in the article on the Diseases of the Lymphatic System.

Neuroma (*νεῦρον*, nerve) is a tumor composed of nervous tissue. The true neuroma is a very rare form of tumor, and is subdivided into the ganglionic or cellular neuroma and the fibrillar neuroma. The GANGLIONIC NEUROMA is found in monstrosities, in the testicles, in the ovaries, and about the sacrum, in the gray matter of the brain, in the spinal cord, and finally in the sympathetic system of nerves. These ganglionic tumors grow slowly, do not attain great size, and are benign if uncomplicated. In extreme cases this neuroma assumes a malignant type by giving rise to rapid recurrence after removal, and even by dissemination. This variety may under exceptional circumstances degenerate into a true sarcoma. Krause has collected from medical literature 24 cases of this kind, and in each case there was found to be associated with the neuroma a fatty or a fibrous tumor, and in some cases a pure round- or spindle-celled sarcoma. Klebs has observed a tumor of this kind about the size of a walnut growing from the floor of the fourth ventricle.

THE FIBRILLAR NEUROMA is divided by Virchow into the medullated or non-medullated according as it contains medullated substance or not. The terms *myelinic* and *amyelinic* are also employed. The medullated nerve-fibres are in conjunction with fibrillar connective tissue, and the node is found on the trunk of the nerve (Fig. 39), or the nodes may

FIG. 39.

Arm in which the musculo-spiral nerve was neuromatous (Campbell de Morgan).

form convolutions and the network is termed plexiform neuroma. The nerve distributed to the part is enlarged and thickened, and its branches radiate so that when the tumor is felt it gives rise to a characteristic peculiar sensation as if angle-worms were beneath the integument. The plexiform neuroma is soft, owing to the presence of myxomatous tissue, which surrounds the nerve like the sheath. The plexiform neuroma is usually congenital, and it is found upon the scalp or the back. This variety of neuroma is not painful as a rule, unless roughly manipulated.

THE TRAUMATIC NEUROMA is found upon the proximal end of a divided nerve after amputation. The neuroma is caused by peripheral irritation, as when the end becomes attached to the cicatrix or adherent to the bone, or possibly by mistake embraced in the ligature. The bulbous extremities vary in size from a small pea to a walnut, and in extreme cases much larger. Traumatic neuroma from the cut end of a nerve is apt to return after operation.

These traumatic neuromata may form independent of an amputation,

as when the nerve-trunk is injured by some instrument or by a foreign body like a piece of glass. It may also arise by adhesion to an inflammatory growth, such, for example, as keloid. The writer has seen the median nerve imbedded in an inflammatory neoplasm in the palm of the hand. The original injury to the hand occurred many years before, and during that long period of time the patient heroically endured the most agonizing pain. The writer advised and performed a surgical operation as a last resort for his relief, as life seemed unendurable with the excruciating pain. The third finger was amputated, and the corresponding metacarpal bone was excised within a short distance from the metacarpal joint. The growth was examined and found to be a keloid, and in it and through it the median nerve and its branches were compressed. The pain ceased immediately, and the agony which the patient experienced in the brachial plexus, and even in the head, was at once and permanently relieved. From the examination of the specimen it is probable that the nerve was injured and nature had made an unsuccessful attempt to repair the damage. In the microscopical examination of the traumatic neuroma there are present the nerve-cylinders, which are completely surrounded by fibrous tissue which forms the club-like extremities to the nerve. In this case sarcoma was said to be present by one pathologist who examined a piece of the tumor, but another pathologist decided that it was a neuroma and keloid, and not malignant. The subsequent history has proved the correctness of the latter diagnosis.

In some cases the oval bulb is composed of connective tissue closely intertwined with nerve-fibres which have undergone various stages of degeneration, so that the mass is as tough and dense as the tissue of a cicatrix. It is a clinical fact that the smallest enlargement often is attended with unmitigated pain, while the largest oval bulb may be attended with very slight amount of suffering.

EPITHELIOMA (ἐπί, upon, θηλή, the nipple) is a tumor composed of squamous epithelial cells which infiltrate the subjacent tissues. Epithelioma is a form of cancer to which the term "cancroid" was applied by Lebert to distinguish it from cancer of internal organs.

Epithelioma, like the other varieties of cancer, derives its chief importance in its clinical history from its malignancy. The tendency of carcinoma of all varieties is to destroy life, not so much from the size of the tumor itself as from its extension to distant and important organs. The dissemination is termed "metastasis," and consists of the power of the cells to form a tumor identical in character in places where the cells have been carried by the blood, but in rare exceptions by the lymph-currents. At the beginning an epithelioma is an innocent tumor, but its capacity subsequently to cause local, regionary, and exceptional cases of metastasis makes it a typical malignant tumor. These cells possess amœboid movements like leucocytes, and it is this power of independent movement that gives to cancer its characteristic. Carmalt in 1872 devoted much study to this amœboid movement of cancer-cells, and showed that the young cells possessed active amœboid movement, while the cells deep in the tumor were passive or motionless. These cells are accompanied in their amœboid movement by leucocytes, which, as Waldeyer has pointed out, form an "inflammatory zone." Even the cancer-cells

can be occasionally observed imbedded in the inflammatory zone; which fact serves to explain the importance of wide excision in case of removal of an epithelioma. These meandering cells explain also regional recurrence after incomplete operations. The cells emigrate to the connective-tissue spaces in and about the epithelial ulcer, and if it happens to be situated in a place which abounds in loose connective tissue, the infiltration is more pronounced.

Epithelioma grows in solid columns of cells from the rete mucosum of the cutaneous and mucous surfaces. These ingrowths or rod-like masses extend inward in the direction of least resistance between the connective tissue in the lymphatic spaces. This arrangement affords an explanation of the occasional dissemination of carcinoma by the lymphatics. The columns send out branches which join similar ingrowths until an irregular network of epithelial cells is formed. Simultaneously with the progress of the ingrowth of the columns of cells there is an outgrowth upon the periphery, and a papillomatous excrescence is formed. The most superficial layer desquamates and the deeper parts become exposed and undergo ulceration. It is the disappearance of the superficial epithelial cells that prevents the epithelioma from attaining any size. The ingrowing columns are associated with a peculiar cell-formation to which the term "nests" has been applied. These nests are composed of central cells which spring from the columns and increase at the periphery. In this manner epidermal globes, or pear-globules as they are sometimes termed, are formed. The lamination is caused by pressure and by atrophy of the other cells. The characteristic hardness of epithelioma is due to horny degeneration of the other cells in the same manner as the skin, the hair, and nails become cornefied.

Epithelioma may start upon the skin or mucous membrane as a slight abrasion, or in a fissure, or the disease may begin as a small wart or nodule.

Epithelioma, or the squamous-celled carcinoma, is situated at the junction of the skin and mucous surfaces, notably upon the lips and face. It is situated also upon the tongue, in the larynx, in the alimentary canal, and in the bladder. The disease is often seen upon the skin of the extremity, and likewise upon ulcers and scars, or the growth may proceed from a sinus which is lined by epithelium. The disease likewise may originate from the surface of an ulcer, or from a burn, or from the cicatrix of a gunshot wound.

The tumor usually begins as a warty excrescence which grows rapidly with widespread dissemination. The wart may also originate in a crack or fissure or start up at a point which has been subjected to unusual irritation. The edges are irregular, indurated, and consist of the proliferated epithelial cells which have not yet been cast off by an ulcerative process. The base of the ulcer is uneven, and is covered with débris and moistened with a foul-smelling discharge.

If the epithelium affects the lips, there is a hypersecretion of saliva and mucus to such an extent that the fluid dribbles from the mouth. Pain is present in consequence of the destruction of the tissues. The adjacent lymphatics soon become involved, and the nodes upon microscopical examination present the same characteristic histological appearances as the primary growth. The nodes often become larger than the

original epithelioma, and may suppurate as a result of tension or in consequence of the entrance of bacteria from the mouth (Figs. 40 and 41).

FIG. 40.

Epithelioma of lower lip.

FIG. 41.

Showing result of operation with formation of lip from the skin beneath the jaw.

Visceral dissemination is rare, although in some cases this may occur. Cartilage is a tissue which seems exempt from infection by dissemination.

Epithelioma of the face usually appears in the form of an irregular ulcer, with the characteristic appearances of a typical epithelium, which has just been described. Early and prompt excision is imperatively demanded, and if these measures can be carried out the prognosis is favorable.

In epithelioma of the face Butlin from many sources collected 206 cases. The operation was performed with 21 deaths, or a mortality of 10 per cent. There were 59 cases whose subsequent histories were unknown, and of the remaining 147 cases, 25 of them had not yet reached the three-year limit of time, leaving 122 whose subsequent histories are therefore known. Of these, 21 died during treatment, and there was a recurrence of the disease in 51 cases. The remaining 50 were permanently cured, giving a percentage of permanent cures of about 41 per cent.

The writer has operated upon 8 cases of epithelioma of the face, excluding lip-epithelioma, with no mortality as far as the operation itself is concerned. In these 8 cases the subsequent histories are all known. In 1 the patient died after many local recurrences in which more than thirty operations were performed, extending over a period of twelve years. The remaining 7 were permanently cured.

Epithelioma has been observed arising from an eczema. The disease has been seen in the scrotum, and resembles Paget's disease of the nipples. A case of this kind has been reported by Dr. Radcliffe

Crocker. The ulcer was situated upon the front and left side of the scrotum and penis. Sir James Paget saw the case, and pronounced it analogous to the nipple disease identified with his name. Mr. Godlee operated upon the patient for Dr. Crocker, and six months later the patient was examined and no evidence of a return of the disease could be found.

A peculiar form of epithelioma is found upon the scrotum, and has been called the chimney-sweep's cancer. The disease begins as a wart situated between the rugæ of the skin of the scrotum. The wart ulcerates, and the adjacent skin quickly becomes involved in the process. The ulceration may spread rapidly and involve the tissues over a considerable area, and, again, the patch of ulceration may be more or less circumscribed and extend into the deeper tissues so as to expose the testicles. The vessels may become involved and fatal hemorrhage occur. The inguinal glands are eventually affected if the progress of the disease is not arrested, and also the lumbar if the disease invades the testicle.

The treatment consists of free excision of the wart, and a good prognosis is to be expected if the operation is performed early and before any glandular involvement has taken place. If, on the other hand, the ulcer has extended, no operation less in severity than amputation of the scrotum, with removal of the testicles and inguinal glands, would be of any avail.

Epithelioma may attack the penis and urethra and the bladder, for a full description of which the reader is referred to the article on Diseases of the Genito-urinary System. Epitheliomata affecting the different organs are fully discussed in the special articles devoted to a consideration of diseases of the organs.

Epithelioma formed of columnar epithelium affects the stomach and intestines, the uterus, ovary, the jaws, and the nasal cavities. The distinguishing feature of the columnar epithelioma is the regularity of the alveoli and cells. The tumor originates from the cylindrical surface-epithelium of mucous membrane or glands. In this variety no pearl globules are found.

The most frequent seat of this variety of epithelioma is the rectum. Dissemination is less likely to occur than in some other forms of carcinoma. If, however, generalization occurs in rectal epithelioma, the liver becomes infected by the portal vessels. This variety forms an indurated mass in the walls of the rectum and leads to stenosis of the bowel. This condition gives rise to intestinal obstruction or to ulceration and hemorrhage.

The cylindrical-celled epithelioma grows slowly, often occupying several years. It is called adenoid or glandular epithelioma, and occurs at an earlier period than other forms of carcinoma. The treatment of this disease consists of excision of rectum, the technique of which is described in the article on Diseases of the Rectum.

RODENT ULCER, or the so-called "Jacob's ulcer," is a variety of epithelioma developed in the derma, and begins as a hyperplasia of the epithelium belonging to the sudoriparous and sebaceous glands and the hair-follicles. The pressure of the growth causes atrophy of the rete Malpighii, but not, as a rule, degenerative changes. The adjacent

lymphatic nodes are even less likely to become infected than in true epithelioma. The rodent ulcer thus differs from a typical epithelioma, which is an ingrowth of surface epithelium, and also in that the cells are smaller and more round and the nuclei spindle-shaped. These cells do not develop any tendency to cornification. There are usually no pearl globules, though in some cases there appears to be an attempt at concentric lamination.

Rodent ulcer seldom occurs before the fiftieth year of life, and is generally situated upon the face, notably upon the side of the nose and at the internal angular process of the orbit; also upon the forehead and over the prominence of the cheek upon the malar bone. The disease may develop on the neck or trunk, but has seldom if ever been observed upon the extremities. It begins as a pimple or a mole instead of a wart as epithelioma. The centre of the pimple soon ulcerates, and the small ulcer may temporarily heal. It soon breaks down again, and heals only to reopen. The ulcer soon attains the size of a quarter of a dollar, with a well-defined though not raised margin. The base of the ulcer is bathed in a thin serous discharge. The lymphatic nodes escape infection, but may enlarge in consequence of irritation, but general dissemination is absent. The disease destroys life by its slow but widespread ulceration, which attacks all tissue, not excepting bone. It may also cause death by hemorrhage or even by a septic meningitis.

Rodent ulcer must not be mistaken for lupus, the base of which is soft and the discharge from which contains the bacillus tuberculosis.

The treatment of rodent ulcer consists of free excision, together with the application of caustic to the base of the ulcer. Potassa fusa, fuming nitric acid, Paquelin's cautery, deliquescent crystals of chromic acid, and Vienna paste are among the agents employed to accomplish the object. Anæsthesia is necessary, and, if this is not advisable for some special reasons, chloride of ethyl and cocaine can be used, with morphia internally to allay the severe pain. If potassa fusa is used, it acts quickly, and its action can be stopped by the application of vinegar and water. The actual cautery must not be used if ether is employed, on account of the danger of explosion.

CARCINOMA (*καρκίνος*, a crab) is a tumor which is composed of epithelial cells which completely fill alveoli, the walls of which are formed of connective tissue.

Carcinoma causes more deaths in the United States in one year than the sum-total of deaths due to erysipelas, tetanus, hydrophobia, lightning, typhlitis, gunshot wounds, joint-disease, together with other well-known surgical affections. Carcinoma is even responsible for nearly half as many deaths as are caused in this country by accidents and injuries of all kinds and descriptions.

I am indebted to Dr. J. S. Billings, U. S. A., for the following established data with regard to cancer and tumors: "The total number of deaths reported as due to cancer in the United States during the year ending May 31, 1890, was 18,536, of which 6989 were of males and 11,578 were of females. This is much below the true number. In the registration area of the United States, including a population of 19,659,440, there were reported during this year 9657 deaths from can-

cer, giving a death-rate of 49 per 100,000 of population, or 33.9 for males and 64.3 for females. This does not include over 1000 deaths reported as due to tumors, many of which were no doubt malignant.

"Including tumors with cancer, the death-rate from these causes in the registration area was 53.1 per 100,000, or 38.8 for males and 69 for females. Among the colored in this area it was 36.6, or 19.2 for males and 53.6 for females.

"In 1890 the death-rate per 100,000 of population from cancer was in England and Wales 67.5, in Scotland 60.6, in Ireland 45.7, in Austria, 52.8, in Prussia 43.1.

"The death-rate from cancer in any locality depends largely upon the number of persons forty-five years of age and upward living in that locality. Thus in the registration area during the census year the death-rates from cancer were (per 100,000 population) for children under five years of age 2.4; for those from five to fifteen, 0.64; for those from fifteen to forty-five, 18.6; for those from forty-five to sixty-five, 162.0; and for those sixty-five years of age and over, 352.0.

"The proportion of deaths from cancer to deaths from all causes has been increasing in most civilized countries for the last thirty years. Thus in England and Wales out of each 1000 deaths from all causes there were due to cancer in 1863, 16.05; in 1873, 21.52; in 1883, 28.14; in 1893, 37.20.

"A part of this increase is probably due to an increase in proportion of old persons in the population, and a part may be due to improvements in diagnosis, as suggested by Dr. Ogle, but these do not seem to fully account for it.

"In each 1000 deaths reported as due to cancer in the registration area of the United States during the year ending May 31, 1890, in males, 404.2 were due to cancer of the stomach; 144.6 to cancer of the liver; 90.9 to other abdominal cancers; 61.6 to cancer of the rectum; 112.2 to cancer of the head, face, and neck; 103.9 to cancer of the lips, tongue, and throat; 19.4 to cancer of the bladder; 12.2 to cancer of the extremities; and 7.9 to cancer of the external genitals. In women, out of each 1000 deaths from cancer 312.5 were due to cancer of the uterus; 172.2 to cancer of the breast; 210.4 to cancer of the stomach; and 108 to cancer of the liver."

The *contagiousness* of cancer has never been scientifically proved. In no case has cancer from the human species produced a cancer in a lower animal. There are a few reported cases where cancer is said to have been transmitted from one animal to another of the same species, yet careful observers are inclined to disbelieve even this statement. Auto-infection has been observed in certain animals as well as in a few human beings.

The contagiousness of cancer from one human being to another has been claimed, but the facts upon which the claim is based are looked upon as strange coincidences. The writer saw in Langenbeck's clinic several cases of cancer of the penis in men whose wives suffered from uterine cancers. Hall has reported 5 cases where cancer attacked both man and wife. Langenbeck believed that it was possible to transmit the disease from the wife to the husband. After a careful research and investigation the contagiousness of cancer seems most unlikely, which

opinion is strongly strengthened by the research of Demarquay, who analyzed 134 cases of cancer of the penis and found the disease present in only 1 patient whose wife had uterine cancer. Enson of Dorset is said to have contracted cancer and died five months after an operation in which he pricked his finger. There are several such cases recorded, but they lack positive evidence of scientific value.

The *infectiousness* of cancer has never been proved, and the few so-called epidemics are explained by other and better reasons. The investigations have all proved the fallacy of this theory.

The *inoculability* of cancer when limited to the same individual has been asserted, and the facts seem to warrant the conclusion that such may be the case. The writer has observed epithelioma of the buccal cavity following upon an epithelioma of the gum and jaw. Williams believes such cases are the result of epithelial tissue-grafts, the same as would result from ordinary skin-grafts. It is more likely that in multiple cancers which affect parts in close juxtaposition the disease had its origin simultaneously from several points of infection, rather than one point by infection cause development of the disease in adjoining or contagious parts.

Climate is said to have an influence in causation of cancer, since the greatest number of cases occur in Europe, while the disease is rare in the East. The North American Indians seem to be practically free from the scourge, and the negro less likely to be affected than the white race.

The **signs** and **symptoms** of carcinoma consist of *pain*, which is present, except perhaps in the colloid variety. The pain is intermittent, sharp, and lancinating, although the manipulation of the tumor itself is not painful. *Hardness* is also a characteristic sign of carcinoma, and this is present only to the same extent in fibroid tumors of the uterus and in the hard chancre. The encephaloid and colloid varieties of cancer form exceptions to this rule. *Lymphatic* enlargement is a sign which is of great diagnostic value. *Adhesion* of the skin is another sign of carcinoma, and occurs in the later stages and leads to ulceration. Dimpling and puckering of the skin are also signs present in carcinoma.

Carcinoma shows a great tendency to disseminate in the different organs or even in bone itself. The cancerous emboli are conveyed by the lymphatics to distant organs, and secondary deposits are formed, the histological formation of which is precisely the same as that of the primary growth. General dissemination of cancer is called "carcinosis," and resembles miliary tuberculosis. The general infection may be accompanied by elevation of temperature, but this is not so common as in sarcoma. The condition arises from the escape of the cancer-cells through a ruptured vein communicating with the primary or secondary focus.

Carcinoma destroys life in various ways—by dissemination if situated in organs like the mammary glands, the bronchial glands, the pleura, lung, or bone; also by dissemination if situated in the rectum, by causing metastasis in the liver; if in the uterus, by ulceration leading to hemorrhage or by nephritis due to pressure upon the ureters or by establishing a carcinomatous peritonitis. If the disease involves the stomach, death is caused by inanition, or if the larynx, by œdema glottidis and suffocation. If the disease is situated in the œsophagus, death

occurs from inability to perform the act of deglutition. The disease may destroy life by exhaustion caused by loss of sleep and appetite and by the presence of pain. Hemorrhage may imperil the patient by the disease ulcerating into the tissues in which blood-vessels are found.

The *classification* of carcinoma is unsatisfactory. The one most in vogue, which divides carcinoma into scirrhus, encephaloid, and colloid, will be employed.

SCIRRHOUS CARCINOMA is a variety of carcinoma in which the fibrous stroma forming the walls of the alveoli is especially abundant and dense. It is found most frequently in the female breast and uterus; also in the rectum and vagina and prostate; also in the œsophagus and stomach. Scirrhus rapidly infiltrates the surrounding tissue and disseminates by means of the lymphatics. It often causes dimpling of the integument, and in mammary cancer a retraction of the nipple. The retraction is caused by a contraction of the prolongation of the tumor toward the periphery, especially in the ligaments of the breast, known as "the ligaments of Sir Astley Cooper."

If a scirrhus is cut into, a creaking sound is heard and the cut surface of the tumor becomes concave. The nodule is surrounded by masses or islands of fat, and is usually well defined. From the surface a milky fluid may be scraped off to which the term "cancer-juice" has been assigned. If the tumor is examined microscopically, it will be found to consist of spheroidal epithelium imbedded in a stroma of fibrous tissue which forms spaces or alveoli.

Scirrhus has a tendency to cause ulceration, and the cells are liable to undergo fatty metamorphosis. Occasionally blood-cysts are formed, and suppuration occurs when the tension is great.

Scirrhus has a peculiar clinical history. The disease begins as a hard lump, which may grow some time before causing any pain or discomfort. When it has attained any appreciable size, it is hard, knobby, and irregular in its outline, and fixed. It may grow very rapidly or it may in rare cases develop very slowly.

Medullary carcinoma is the variety of cancer in which the stroma is relatively slight in amount, and the alveoli larger than in simple or in scirrhous carcinoma. The distinguishing feature of the medullary carcinoma is its large alveoli with very thin walls, which are made up of finely-fibrillated connective tissue. It is the presence of the thin alveolar wall and the large spaces that give the tumor its soft brain-like appearance. The proportion of cells is greatly in excess of the stroma.

The encephaloid carcinoma may grow very rapidly and attain a large size, and may destroy life in less than a year. This variety of carcinoma has large knobs upon it, and quickly ulcerates so as to cause hemorrhage, to which the term "fungus hæmatodes" has been given. The centre of an encephaloid often breaks down, so as to give evidences of fluctuation, and the periphery of the tumor is made up of the tissue which resembles brain-matter. Cysts are very common in encephaloid carcinoma. These cysts are filled with bloody fluid, and the cells occasionally are infiltrated with melanin. Encephaloid is found in the liver, bladder, testicle, kidney, ovary, and female breast.

COLLOID CARCINOMA is a tumor, the distinguishing feature of which is the mucoid or colloid degeneration of the epithelial cells. If a colloid

carcinoma is cut into, the tumor presents an irregular network of alveolar spaces which are filled with a jelly-like mass. The centre of the growth is soft, while the periphery may resemble the scirrhous variety of carcinoma. If a microscopical section is made, the alveoli and the stroma are present as in the other varieties of carcinoma. The cell is filled with colloid material, which displaces the nucleus and finally bursts the cell. This same process affects a large number of the cells, and also the stroma. The degeneration thus begins in the protoplasm of the cells. The stroma undergoes softening and liquefaction, so that adjoining alveoli are subsequently merged into large spaces formed by the obliteration of the walls of the small alveoli.

Colloid carcinoma is found in the stomach, intestine, female breast, and ovary. It may grow rapidly and quickly cause death, although it is usually a slow-growing form of carcinoma. This variety of cancer affects the viscera and peritoneum.

The **prognosis** in carcinoma varies according to the variety. In the epithelial ulcer and in the rodent ulcer the prospects of permanent recovery are favorable, provided the disease is removed early and before dissemination has occurred, and by an operation which is extremely radical.

In the scirrhous, medullary, and colloid varieties the same rule applies, but in these cases the danger is greater, as the disease is more malignant. The writer has observed that the more typical the structure the better the prognosis, and the more atypical the structure the more unfavorable the prognosis. The reader is referred to the articles on the Special Surgery of the parts for a more complete knowledge of the prognosis of cancer as it affects the individual organs.

The **treatment** of all varieties of carcinoma consists of complete excision and also removal of any lymphatic nodes.

The special technique involved in the removal of carcinomata involving special organs is fully discussed in connection with the surgery of the part.

ADENOMA (ἀδήν, a gland) is a tumor composed of tissue which is identical with that of true gland-tissue and develops independent of the gland itself.

Adenoma may contain acini and ducts similar to those found in racemose glands, and yet in no way be connected with the acini and ducts of the gland from which it springs. The tumor is found encapsulated in the liver, thyroid, mamma, and parotid; but if situated in the mucous membrane of the rectum or bladder and uterus, the growth is not encapsulated, but is pedunculated. The tumor may grow from a secreting gland, but it is incapable in itself of secreting like the normal gland from which it takes its origin. Adenoma, however, may secrete a fluid with certain peculiarities, but the secretion is retained and is not discharged by the gland-ducts. The fluid is chiefly composed of mucous degeneration of the constantly proliferating epithelium. In the typical adenoma there is more than the increase of the interglandular tissue, and the growth is often associated with cysts which are formed by the dilatation of the newly-developed acini and tubules of the neoplasm. The tumor may vary in size from an almond to a cocoanut, and weigh from a few ounces to forty or fifty pounds. The adenomatous tumor grows

slowly, is usually single, but may be multiple, affects young people as a rule, and at a time when the function of a gland is most active, and has no secondary gland-involvement. The tumor if cut has the appearance of a fibroma in many respects, and the cysts are filled with an opaque serous fluid which sometimes is gelatinous in character. In one specimen the writer observed small islands of cartilage within the cyst as well as papillomatous growths.

The tumor is composed of a fibrous matrix with numerous blood-vessels running through it. In the stroma are seen the tubes and the acini in the different stages of development. The characteristic peculiarity is the presence of epithelial cells, and the tumor often is influenced in its growth by the excess of the epithelium on the one hand or the excess of fibrous tissue or stroma on the other hand.

If the former condition prevails, the tumor is cystic and is called a cystic adenoma; if the latter, the tumor is solid and has been called fibro-adenoma. The fibro-adenoma has a distinct capsule and is oval or round in shape, and rarely exceeds an apple in size. It is firm, and slips readily under the skin when it is examined by the surgeon. If it lies upon the superficial part of the body, it may cause a tumor which is felt just under the skin.

The cystic adenoma is also encapsulated, and the cysts are dilated acini and ducts which are lined by epithelium. In the centre of the cyst are often found independent growths of a papillomatous nature which are termed intracystic growths. The adenoma is essentially a benign tumor in the beginning, but the danger of its transformation into an epithelioma or a sarcoma must not be overlooked, since this possibility gives to this tumor a peculiar future significance, and gives rise to little or no pain. It is found in young people, and if situated in the breast often becomes painful at the catamenial period.

The **treatment** of adenoma is removal by the knife. The tumor cannot be absorbed by any known remedies either externally applied or internally administered. If the tumor exists in a young person and can be excised without the removal of the whole gland in which it is imbedded, the attempt should be made, since the growth is not primarily malignant and is circumscribed. If the adenoma is large and painful and occurs in a patient beyond forty years, the entire gland should be removed. In deciding this question the dangers of malignant degeneration must not be overlooked. Adenoma should be removed, because by its mechanical pressure it destroys the gland in which it is imbedded, and also because the adenoma is likely to become malignant under certain conditions, especially in glands whose functions becomes obsolete by age. This is especially true in the case of adenoma of the breast occurring at the time of the catamenia, when the normal mammary gland undergoes certain retrograde changes.

Adenoma is an example of a tumor which may exist without the slightest harm, and, on the other hand, may be the starting-point of carcinoma.

The possibility of such a change taking place is the strongest argument in favor of removal of an adenoma, and without doubt the evidence is overwhelming that an adenoma may be transformed into carcinoma.

Cystoma (κύστις, a bag or sac) is a tumor containing one or more

cavities whose walls are formed by connective and fibrous tissue, and occasionally by muscle-fibre, and the interior of which is lined by epithelial cells. In the walls of a simple cystoma follicular depressions are observed which are covered by ciliated epithelium. Near the original cyst smaller ones may arise by the ingrowth of epithelium, so that the solitary cyst may become multilocular. Adenomatous tissue often develops in connection with cystoma.

The interior of the cyst is lined with epithelium, and the cavity itself is filled with fluid. The walls are formed as a result of irritative inflammation caused by continuous pressure, or the walls may be formed in consequence of the presence of some foreign body. The fluid contained within the cyst varies according to the nature and locality of the cystoma. The contents may be serous, mucous, gelatinous, or albuminous in character, or the contents may contain bile, saliva, blood, or urine. If the fluid is albuminous, fatty degenerated cells, fatty molecules, and crystals of cholesterin are also formed.

The cystoma may result from the dilatation of a normal duct, cavity, or sac in the body, or by extravasation of blood, or in consequence of the presence of inflammatory exudates.

Cystoma may be divided according to certain anatomical peculiarities of the cyst. There are retention, implantation, tubercular and gland-cysts; also hydroceles, hygroma and hydatid cysts, and dermoids.

THE RETENTION-CYST is formed by some mechanical obstruction to a natural excretory duct, so that the fluid is prevented from escaping at its normal outlet. A retention-cyst forms in glands that produce a secretion or excretion which is discharged by a duct opening upon the skin, mucous membrane, or a serous surface. The mechanical obstruction giving rise to a retention-cyst may be caused by inflammatory changes, by narrowing of the lumen of the excretory duct, by flexion of the duct, by a change in the character of the secretion, by the presence of a foreign body or a tumor, by a calculus, by valvular closure, or, finally, by a mass composed of parasites. A typical illustration of a retention-cyst is observed in the comedo upon the face: sebaceous cyst is due to obstruction of the small excretory ducts. Another illustration is in the crypts found in mucous membrane. This produces dilatation of the part behind the obstruction, and a cyst is formed in consequence. The newly-formed cyst by its continuous presence causes atrophy of the affected portion of the gland, so that, unless the condition is relieved, eventually the duct and the cyst become merged into a large cavity containing the special variety of fluid that is secreted by the gland under normal conditions. In the retention-cyst the swelling is caused by the retention in a pre-existing cavity of the secretion or the excretion of the duct or gland.

The **signs** of a retention-cyst are the presence of a swelling which has increased slowly or rapidly according to the character and size of the obstruction and the amount of normal secretion of the gland. Pain is absent unless inflammation is present; transparency is present if the wall is thin and the fluid clear; also fluctuation, with an elastic feel upon manipulation; finally, a tumor situated in the position of the affected organ or gland.

SPERMATOCELE is an example of pure retention-cyst. The sac is

formed by a diluted tubule in the epididymis, and the fluid contained within it is the secretion of the testicle, in which of course spermatazoa are found. The appearance of the fluid is similar to that of milk, and usually the cyst attains the size of a walnut. The writer has seen several large spermatoceles, one of which reached to the knee. The patient, whose occupation was that of a butcher, was able to hide the deformity by wearing a large long apron reaching to his feet. In these cases the tubule may rupture and discharge its contents into the cavity of the tunica vaginalis.

HYDRONEPHROSIS is an example of a retention-cyst. In this case the ureter becomes blocked, and in consequence the pelvis of the kidney become dilated by urine and the infundibula become dilated into good-sized tubes, and a large cyst is formed. This eventually leads to destruction of the function of the kidney by atrophy, and gives rise to surgical kidney if the cyst becomes infected, and finally leads to death unless surgical interference relieves the condition.

HYDROSALPINX is another illustration of a retention-cyst. In this case the fimbriated extremity of the Fallopian tube becomes obstructed for various reasons, and a dropsical effusion occurs in the tube, so that by its dilatation a retention-cyst is formed.

Peritonitis often causes obstruction in the tube if the proximal extremity is involved, usually due to gonorrhœal infection by closing the tube which causes the retention-cyst.

HYDROKOLPOS is a retention-cyst developed in consequence of closure of the cervix above and atresia of the vaginal lips below. The vaginal secretion collects in the canal and causes a large cyst. If blood is contained in the vagina, a hæmatokolpos is formed.

HYDROCHOLECYST is still another example of retention-cyst. In this case the duct becomes obstructed by a gall-stone and a dilatation behind the point of obstruction occurs, and a large retention-cyst is developed.

HYDROMETRA is observed during the process of involution of the uterus after the menopause. This retention-cyst is caused by closure of the cervical canal and accumulation of the secretion of the uterine glands, which secretion eventually is transformed into a serous fluid.

Retention-cysts are a source of danger, because they destroy the function of the gland involved or by their size interfere with the functions of adjoining organs. If bacteria gain access to the innocent fluid contained in the cyst, the character of it is at once changed and suppuration ensues. The prefix *pyo-* is now substituted for the first syllable, and different terms are employed to indicate the condition. Thus pyonephrosis, pyosalpinx, pyocholecyst indicate the purulent character of the fluid in the retention-cyst.

Many other examples might be mentioned, but these few serve to clearly explain the formation of retention-cysts.

The prognosis in retention-cysts largely depends upon the organ affected and the consequences of microbic infection. Thus, a retention-cyst formed in consequence of an obstruction to the ureters would be serious, whereas a retention-cyst involving a gland of no special physiological importance would be insignificant. The situation of the cyst in case of rupture is an important factor in considering the prognosis, since a rupture of the sac into the peritoneal cavity is attended with

great danger, and the same accident occurring in a cyst upon the periphery of the body is harmless. A cyst may remain harmless until by some unknown way bacteria gain access, and then a suppurative process is established which may lead to general infection.

The **treatment** of retention-cyst depends upon the situation and character of the fluid contained in the interior of the sac. The special technique involved in each kind is fully discussed in the articles devoted to a consideration of the particular organs involved. The general principles embracing any operation for the removal of retention-cysts include in some cases aspiration, and in the event of failure a complete excision of the cyst with the gland. The cause of the obstruction should always be removed, if possible, as the first step in the treatment; if this cannot be accomplished, a fistula should be made for the purpose of drainage or else the entire cyst excised. The treatment must necessarily depend upon the cause. If the obstruction is due to inflammation, measures should be taken to modify or control it; if to impaction, the removal of the calculus or foreign body is necessary; if to stenosis, a dilatation of the duct is indicated or the formation of a temporary fistula is required. If the cyst cannot be cured by any of these means, excision is to be performed. The cyst should be cut down upon and the sac removed in its entirety. If this operation is not practicable and the cyst has ruptured, the sinus can be enlarged and the cyst-contents scraped out, and a tampon of iodoform gauze inserted into the cavity. The cyst then becomes obliterated by a process of granulation.

IMPLANTATION-CYSTS owe their origin to some traumatism affecting the part, by which a graft of skin or epithelium or hair-bulbs have been transplanted into the subcutaneous tissues. Injuries by puncture, by glass, by needles, by awls, by teeth, etc. usually give rise to this variety of cyst. The cyst contains a cavity lined with epithelium and filled with fluid. The walls of the cyst are made up of fibrous tissue and inflammatory new-formation. The implantation-cyst is found most frequently upon the palmar surface of the finger. Weber has reported a case of implantation-cyst which was situated upon the external occipital protuberance. The cyst was lined upon the inner side by skin from which hair grew. In the cavity was mucous and sebaceous material. The implantation-cyst has been observed in the iris, and Hulke states that in nearly all of the cases there was a history of traumatism of the eye. He believed that a piece of Descemet's membrane was torn from the cornea and implanted upon the iris. Collins has demonstrated the presence of implantation-cysts in the cornea, and has shown that they result from some traumatism by which the epithelium of the conjunctiva has been implanted into the deep layers of the cornea. Implantation-cysts have been seen on the trunk and face.

The **treatment** of implantation-cyst consists of complete excision and healing by primary intention.

THE TUBULAR CYST is in marked anatomical contrast to the retention-cyst, since it takes its origin in functionless ducts. These ducts in the embryo have some function to perform, but their function ceases after birth. The urachus, if it remains patent, is an illustration of one of these tubular cysts. The writer saw three of these allantoic cysts at

one time occurring in young people, a report of which he has elsewhere published. Fluids containing coloring matter and potash were injected through the umbilicus into the bladder, and by chemical analysis the potash was found in the urine, which was passed by the urethra, and also the coloring matter.

The vitello-intestinal tubular cyst is another example.

GARTNER'S CANAL, which is the excretory duct of the corpus Wolffianum, occasionally remains patent and gives rise to a tubular cyst. The science of embryology has recently demonstrated that the Wolffian duct is derived from the epiblast of the fœtus, and for this reason the cyst is regarded as a variety of dermoid. Tubular cysts connected with the paroöphoron and parovarium and the testicle also are included in the number of tubular cysts.

GLAND-CYSTS are formed in connection with salivary, lachrymal, and pancreatic glands.

RANULA is a familiar example of a gland-cyst. In this case the excretory ducts of the submaxillary, sublingual, and Blandin-Nuhn glands become obstructed by a calculus or some other cause, and a large cyst develops beneath the under surface of the tongue between it and the gum. The cyst has a very thin wall and is filled with saliva and mucus. Some pathologists also include in this class the cyst developed in Stenson's duct from the parotid gland—a cyst, however, which is rarely observed.

The term ptyalectasis has been also applied to this condition, but if the duct is ruptured the term ptyalocele is used. There is still some diversity of opinion as to the origin of ranula: some pathologists believe that it is a true hygroma, since ptyalin and potassium sulphocyanide are not found in the fluid of a ranula. In opposition to this view it is claimed that the fluid in the cyst undergoes certain chemical changes which deprive it of these two characteristic elements of a salivary secretion.

The **treatment** of ranula is to excise freely the cyst and to scrape well the cavity which contained the ranula, and then to pack the wound with some antiseptic gauze in order to have the wound heal by granulation. During the healing process the mouth must be kept as aseptic as possible.

DACRYOPS is a dilatation of the ducts connected with the lachrymal gland. The tumor appears under the external part of the eyelid. This cyst is due to an obstruction of the duct in consequence of some inflammatory condition. This cyst, like that belonging to Steno's and Wharton's ducts, is very difficult to cure, as a fistula forms which prevents healing.

For the **treatment** of dacryops the reader is referred to the article on the Surgery of the Eye.

PANCREATIC CYST may be formed by an obstruction to the duct, and in consequence a dilatation of the canal of Wirsung occurs. The duct has been found obstructed by a calculus, and yet no cyst developed behind it, but the pancreas atrophied. This same phenomenon has been observed in experiments upon animals in whom the duct has been ligatured.

In some cases the cyst forms independent of any pancreatic calculus.

A segment of the duct is sometimes obstructed by the pressure of an abdominal neoplasm which has caused cicatricial contraction of the canal (Fig. 42). The pancreatic cyst has been known to arise in connection with an obstruction due to an impacted gall-stone at the opening of the ductus communis choledochus into the duodenum.

FIG. 42.

Pancreatic cyst (Warren Museum)

The **cause** of pancreatic cyst is not definitely known, although it has been assigned to traumatism. In these cases it is supposed that the pancreatic gland has been lacerated, which permitted the secretion to extravasate into the retroperitoneal region. Fatal hemorrhage into the cyst may occur, which forms a peculiar clinical feature of this disease. Senn in 1885 contributed a most valuable article upon the subject, to which the reader is referred, and to which the writer is indebted for some interesting facts in connection with the development of this variety of cyst.

In some cases the cyst attains great size, so as to hold several gallons. The tumor has a retroperitoneal situation, with the transverse colon and stomach lying in front of it.

The fluid in a pancreatic cyst contains a trace of albumin with a specific gravity of 1010 to 1020. It is generally turbid, and has a greenish tint, but may be clear or white like milk. Tyrosin, blood-pigment, and mucin are also found in the fluid, which has the power of emulsifying fats.

The **treatment** consists of an abdominal section in order to expose the cyst, which should be emptied by a trocar and cannula, and then drawn out so as to be stitched to the abdominal parietes and drained. In some cases a counter-opening has been suggested in the loin with a view of more fully draining the posterior part of the cyst.

CYSTS termed hydroceles are found in the tunica vaginalis of the testis; also in the cervico-branchial clefts, in the round ligaments of the uterus, and in conjunction with hernial protrusions and ovarian pouches. In these places there are natural cavities formed of serous surfaces from which the fluid is secreted. Whenever there is a hypersecretion of the fluid the cavity becomes distended and a well-defined cyst is formed.

In addition to the *true* cysts just described there are *false* cysts. These false cysts, sometimes termed pseudo-cysts, are usually of a congenital origin, although a few may be acquired.

Among the congenital false cysts may be mentioned Meckel's diverticulum (Fig. 43), as well as those which spring from the appendix vermiformis, the bladder, the pharynx, œsophagus, trachea, and larynx.

FIG. 43.

Meckel's diverticulum.

Hydrocephalus, meningocele, the meningo-myelocele, the cephalocele, and spina bifida are among the congenital varieties of pseudo-cysts, which are also classified as neural cysts.

The **treatment** of these different varieties of false cysts is considered in the articles which are especially devoted to a consideration of these subjects.

A *cyst* is frequently found in connection with a joint. In this case the synovial membrane protrudes through a tear in the capsule, to which condition the term synovial hernia has been given. The cyst may develop from the synovial membrane itself or it may appear as a diverticulum. It sometimes happens that the capsule of the joint undergoes cystic degeneration from hypersecretion of the synovia.

The **treatment** of this variety of cyst involves opening the joint and excising the cyst, and this step can only be taken when the most rigid rules of antiseptic surgery can be enforced.

GANGLION is a variety of cyst which forms in the vicinity of a joint. The ganglion consists of a round elastic tumor which is situated in the subcutaneous tissue in close proximity to a joint, notably those found upon the foot and hand. The cyst is a hernial protrusion of the synovial membrane, thus forming a cavity or pouch in the interior of which synovia is contained. The pouch is connected with the joint by a pedicle, which often becomes impervious like the tunica vaginalis of the

testicle. In this case the cyst becomes detached from the joint and forms an independent cyst disconnected with the joint-cavity. These ganglia may occasionally form in consequence of cystic degeneration of the capsule from hypersecretion of the synovia.

The **treatment** of a cyst of this variety consists in rupturing the sac by mechanical violence or by subcutaneously puncturing the wall by a very narrow-bladed knife, and at once exerting uniform, equable pressure over the site of the swelling. After either of these methods the cyst is apt to refill, and since the introduction of antiseptic surgery complete excision of the sac has been employed with aseptic healing.

Cysts sometimes develop in connection with the sheath of a tendon, to which the term hydrops tenovaginalis or hygroma of the tendon-sheath has been given. The cyst most frequently forms in connection with the flexor tendons of the hand under the annular ligament and in the palm, also in the fingers and upon the dorsum of the wrist. The sheath of the tendon undergoes a cystic degeneration, accompanied by a hypersecretion of the synovia in excess of the amount normally required for lubrication of the tendon within the sheath. The swelling is seen in the palm of the hand, and the fluid can be pressed upward under the annular ligament, and when the pressure is remitted the fluid again flows back into the palm. In consequence of the mechanical obstruction there is more or less rigidity of the fingers. In some cases the swelling is circumscribed, and is situated upon the dorsum of the hand in connection with the extensor instead of the flexor muscles. The synovia after a while becomes thick like warm gelatin, and often in the fluid white seeds consisting of pure fibrin are found. The presence of these kernels, which are often called rice-seeds, gives the swelling a peculiar sensation under the surgeon's fingers during an examination of the cyst. They may be so abundant in the sac that the fluid will not escape through an ordinary cannula. If the surgeon moves the patient's finger, there is heard a friction sound or creaking which is pathognomonic of this condition.

The **treatment** of cysts of the tendons or ganglions consists of opening the sheath under rigid antiseptic precautions, scraping out the contents, and sewing the wound up so as to obtain primary union. Great emphasis is placed upon the antiseptic precautions, as otherwise suppuration might ensue and the fingers become permanently stiff and useless. The operation of tapping the cyst when the fluid is clear and the employment of uniform compression can be tried, or even rupture of the sac by mechanical violence. The injection of irritating fluids after evacuation of the contents of the sac with a view to adhesive inflammation of the sac is an operation that cannot be recommended as possessing any advantages over the modern operation of excision under aseptic precautions.

Hygroma (*ὑγρός*, moisture, and *ωμά*, "indicative of the material result of a process," Foster) is a cyst connected with a bursa. Bursæ mucosæ are sacs whose outer walls are formed by connective tissue, and the inner walls of which are lined by endothelium which secretes synovia. These bursæ are situated under the skin and over bony prominences, and act as cushions over parts which are subjected to continual pressure and friction. They are chiefly found around the knee- and

elbow-joints, over the tuberosity of the ischia, and upon the dorsum of the hand. They are also found in other places in consequence of some unnatural pressure, as in kyphosis, or over the sternum in shoemakers, who subject this region to intermittent pressure in their work; also among miners, whose elbow-joints have cysts upon them in consequence of pressure upon the olecranon.

The hygroma is often seen in carpet-layers, in Sisters of Charity, and in housemaids. It is also seen upon the acromial end of the clavicle in railway porters, who carry trunks upon the shoulders. It is also observed upon the head of the metatarsal bone of the great toe in persons who wear tight-fitting shoes; also in the neck between the hyoid bone and the thyro-hyoid membrane. It is also observed as a result of injury, such as a sprain or contusion.

If any of these bursæ become the seat of acute inflammation, a hypersecretion of synovia occurs and a well-defined, painless, elastic tumor forms. It often happens that the hygroma has communication with the interior of a joint, a clinical fact which must not be overlooked. The fluid is often thick and mucoid in character and contains so-called rice-bodies in which the bacilli tuberculosis are sometimes imbedded.

In hygroma there are found small excrescences which undergo fibrinoid degeneration. These excrescences are often pedunculated, and by friction are detached from the inner surface and form the corpora oryzoïdea. This fibrinoid tissue may contain bacilli tuberculosis. These rice-bodies are detached villous growths which are found in the sac, and are often augmented by the deposition of albuminous and fibrinous material derived from the synovia.

In the hygroma small pieces of cartilage are found, and in some cases their number is quite large. The corpora oryzoïdea may have a tubercular origin. The walls of the hygroma may become thickened and give rise to endothelial growth, as shown by Morisani, or even become sarcomatous, as Mikulicz has pointed out in his interesting contribution upon this subject. It occasionally happens that the hygroma is subjected to mechanical violence, and hemorrhage takes place in the sac from the injured wall, in which case the fluid becomes bloody.

The **treatment** of hygroma consists of puncture and antiseptic irrigation and compression or complete excision of the bursa and healing by primary union.

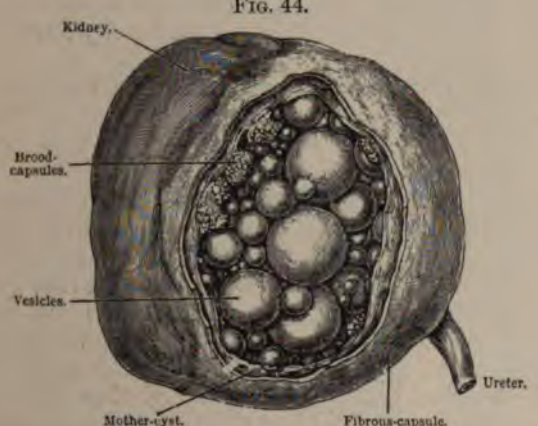
HYDATID CYST (ὑδατίς, watery vesicle) is due to the presence of a parasite known as tænia echinococcus. The parasite is like a miniature tapeworm, and infests the intestine of the dog, the wolf, the jackal, and in rare instances the cat. The parasite gains access to the human being through the medium of food and water which have been infected by the eggs of the worm, and the parasites pass out in the fæces of these animals. Oxen, sheep, and swine also harbor the parasite and act as conveyors of the parasite to dogs. When the eggs are thus ingested the chitinous membrane surrounding them is dissolved by the action of the gastric juice, and the ova are thus set free to be taken up by the blood and lymph and carried into the general system. The direct anastomosis between the blood-vessels of the intestine and the liver affords a most convenient channel of infection in the liver, an organ in which the

echinococcus cyst is most frequently found, although the hydatid cyst may affect almost any organ or tissue in the economy.

The cestode worm itself is nearly a quarter of an inch in length and is divided into four segments. The first segment contains the head with four suckers and the rostellum, upon and encircling which is a ring of calcareous hooklets nearly fifty in number. The second and third segments contain nothing of special interest. The fourth segment contains an hermaphroditic sexual apparatus with a papilla corresponding to the male sexual organ.

As soon as the ova gain access to the human body there arises an intense irritation in the part, which results in inflammation with its attendant cell-proliferation and the development of fibrous tissue, which forms a wall about the offending parasite. Within this fibrinous and membranous capsule or enclosure the true echinococcus cyst now develops. The cyst proper has two layers: the external one has been called ectocyst, and is highly vascular, and the internal one is termed

FIG. 44.



Echinococcus-colony in the kidney (Museum Middlesex Hospital).

endocyst, and is a granulation surface from whose walls buds are thrown out which subsequently develop into the scolex. Within this parent cyst are daughter cysts, which develop from the granulation surface in large numbers, and in like manner scolices are produced. The daughter cyst may develop for many generations, so that even thousands are formed (Fig. 44).

The scolex is very small, averaging only about one-fiftieth of an inch, and is surrounded by a parenchyma in which are found calcareous deposits. The hooklets are found in the anterior part of the scolex.

The fluid contained within the parent as well as the daughter cyst is clear in color, has a specific gravity of 1005, and is alkaline in reaction, due to the chloride of sodium. It contains no albumin, and therefore does not coagulate by the application of heat. Tyrosin and fucin are observed in the hepatic hydatid cyst and uric and oxalic acid in the renal hepatic cyst.

The distinguishing feature of the fluid under the microscope is the

presence of the parasite. If hemorrhage occurs into the sac, traces of albumin may be found in the fluid.

The hydatid cyst may be single or multiple, and at least five months are required before the cyst attains the size of a horse-chestnut. The cysts may grow so large as to rupture into the organ or tissues, and finally escape by absorption or disappear by a process of suppuration. They are more frequently observed in women than in men, and usually between the ages of thirty and forty.

The cyst may sometimes be filled with blood, which under these circumstances undergoes degenerative changes and the parasite is destroyed. The fluid is then coffee-colored instead of clear.

Hydatid cysts may remain barren, in which case the term acephalocyst has been applied. In some cases, notably in the liver, the cyst may be multilocular, without the brood or mother cyst with the daughter cysts. In these cases many vessels are seen enclosed in a fibrous cyst in which are numerous trabeculæ or partitions. The vesicles are found studding a gelatinous mass enclosed in the fibrous compartments.

Hydatid cysts are found in all countries, but more especially in Iceland, Australia, and Silesia. They are occasionally found in England and the United States.

The frequency with which hydatid disease is found in the United States has been shown by Sommer, who has tabulated the cases with great care. The results of his figures are hereby appended: "In summing up, we find that out of 67 cases in man recorded in this country, 1 was a Swede, 2 in French persons, 3 in English persons, 3 in Italians, and 5 in Germans, while 2 persons were given as simply foreigners; 2 were negroes, 2 mulattoes, while the remaining were unstated. Thus we have, out of 63 cases among whites, 17 in foreigners; the nationality of the remaining whites not being stated, leaves room for a possible greater number of foreigners. Again, 24 cases were recorded as in males and 15 in females; but, as in the remaining 26 the sex was not given, no value can be attached to these figures, though they at first seem to contradict foreign statistics, which place the percentage among females far above that of males.

"The following is the geographical distribution:

New York	24	Louisiana	1 or (2)?
Missouri	4	Massachusetts	1
Pennsylvania	3	California	1
Ohio	3	New Jersey	1
Alabama	2	Vermont	1
Virginia	2	Washington	1
District of Columbia	2	Texas	1 (+)?
Illinois	2		

New York State is evidently the only point of concentration, the remaining patients being well scattered."

Sommer also shows that hydatid disease is most frequent between the ages of thirty-one and forty, and that the following organs were affected in point of frequency in the order mentioned: "Liver, 39; lung, 5; passed by rectum, 2; spleen, 3; brain, 3."

The symptoms of hydatid cyst are the presence of a smooth, tense, elastic tumor, in which a vibratory thud can be felt by tapping upon one

side of the swelling while the surgeon's hand or fingers rest upon a point opposite. Puncture of the cyst and examination of the contents of the fluid for the presence of the hooklets make the diagnosis certain. Tapping hydatid cysts in the great cavities of the body may give rise to serious symptoms, owing to infection. In such cases the surgeon should be ready to proceed at once to operate.

The most frequent seat of the hydatid cyst, as has already been mentioned, is in the liver (Fig. 45), next in point of frequency the lungs,

FIG. 45.

Hydatid cyst of liver (Francis H. Markoe).

and then the kidneys. The cyst may be found in nearly every organ and tissue of the body.

Hydatid cysts may exist for some time and give rise to no serious disturbance. They may in exceptional cases attain great size and by their pressure-effects destroy organs and tissues. It sometimes happens that a spontaneous cure may be brought about by death of the parasite, in which case the fluid may undergo absorption, the cyst-walls collapse, and the capsule undergo cicatricial contraction. Within the collapsed cyst a caseous mass in which calcareous matter is found is the only remains of a once-active hydatid cyst. If the full cyst rupture, the contents may escape into some large cavity like the thoracic or abdominal, and cause sudden fatal collapse or set up inflammation, from the immediate effects of which the patient may die.

The **treatment** of hydatid cyst consists of opening and draining the cyst or else completely excising it. If the cyst is situated upon the surface of the body, the best treatment is to remove it entire by excision.

If, on the other hand, the cyst is contained in a serous cavity, the nature of the operation depends upon whether there has been an antecedent inflammatory attack. If there has been no inflammatory attack, so as to cause adhesion between the serous membrane and cyst, Volkmann has devised an operation which consists of an incision down to the cyst-wall and packing the open wound with iodoform gauze. This completes the first stage of the operation. The wound should be left alone until adhesions have formed in consequence of the inflammation due to the operation. The second stage of the operation can be performed at the expiration of a week and the cyst opened and drained. The adhesion of the peritoneum to the outer or external parts prevents any infiltration of the contents of the cyst into the serous cavity. Instead of performing the operation in two stages, physicians have of late executed the operation at one sitting by stitching the cyst to the serous membrane and to the walls of the wound. The cyst is now evacuated and drained. If the operation can be done so as to prevent any possible infiltration, it is an ideal one, but so many fatal results have attended the procedure that surgeons are inclined to perform the operation in two stages. Simon advised passing a long curved trocar and cannula through the external parts into the cyst and out again, and leaving the instrument *in situ* to excite inflammatory adhesion, and when this was accomplished to open and drain the cyst. This method is open to the objection that septic infection may occur.

The cyst may be opened through the thoracic cavity by resection of a rib when the disease affects the upper surface of the liver or the subphrenic region. The lower portion of the pleural sac is often obliterated when the cyst is situated in this vicinity, which explains the safety of operating through the pleural cavity. If no obliteration has taken place, the parietal layer of the pleura must be sutured to the diaphragm, and then the incision made as already described. In hydatid of the kidney the cyst may be operated upon by an opening behind in the lumbar region.

Landau has suggested suturing the liver to the wound made in the abdominal parietes and then opening the cyst. If a cyst has ruptured into the peritoneal cavity, abdominal section must be performed at once, and irrigation of the peritoneal cavity with sterilized fluid be employed.

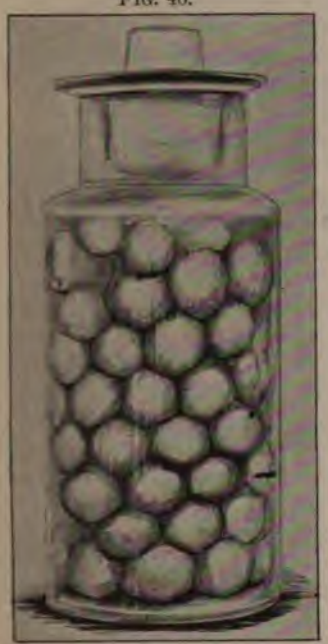
DERMOID CYSTS are composed of fœtal structures, chiefly skin and mucous membrane, viscera, teeth, and hair. They are found in places where such tissues do not anatomically belong.

Dermoid cysts are congenital, although they may not become apparent until puberty. Dermoid of the ovary, however, may be an exception to this rule. Dermoid cysts are situated usually in those places where the germinal layers in the fœtus blend along the median line of the body from the occiput to the coccyx or from the chin to the xiphoid cartilage, in the facial fissures, also in the naso-facial sulcus, in the hard palate, in the tongue, and in the auricles. The wall of a dermoid cyst is formed sometimes of mucous membrane, but generally of skin, upon which are imbedded papillæ, hair-follicles, and some sebaceous, mucous, salivary, and occasionally sudoriparous glands. Within the cavity of the cyst are found remnants of viscera, plates of bone, teeth, balls of hair, and

also the secretion from the above-mentioned glands (Fig. 46). The increase in the size of a dermoid cyst is explained by the slow accumulation of the gland secretions. In addition there have been found in the dermoid cyst pieces of cartilage, muscular fibre, patches of cylindrical or ciliated epithelium, finger-nails, portion of an eye, and in one remarkable case a mammary gland.

The hair found in the dermoid cyst in the human being is of fine texture, light brown in color irrespective of race, while in the dermoid of birds feathers are found instead of hair, and

FIG. 46.



Balls of fat from dermoid cyst (Mundé).

FIG. 47.

Dermoid of the scalp, connected by a pedicle with the dura mater (Museum Middlesex Hospital).

in swine bristles. The hair grows from hair-follicles, as in the normal skin. In the aged the hair becomes white, and in some places alopecia has occurred.

Besides hair, there are found in the conglomerate mass of a dermoid fat-globules, crystals of cholesterin, also epithelial cells which have undergone fatty degeneration, and in a few cases pure oil.

These cysts, except in the ovary or rectum, do not usually attain any special size, unless by some accident microbic infection has occurred. Inflammation may become established and pus form, and the tumor suddenly become very large, fluctuating, and painful. Under these circumstances the dermoid may become a source of imminent danger to life. In case of sudden enlargement of a dermoid this important clinical fact serves to explain the transition of an otherwise ordinarily harmless dermoid into one of a most serious character.

The presence of these various structures and tissues is explained by the inclusion of parts from the mesoblast and also from the epiblast. The dermoid may be situated in the ovary within the oöphoron and in the orbit. Lebert has demonstrated that of 188 dermoids, 129 were situated in the ovary. Dermoids are also found in the eyelids, in the neck corresponding to the first three branchial cysts, over the parotid gland, at the angle of the eye, and upon the floor of the mouth.

They are also observed upon the skull attached to the periosteum near the fronto-maxillary suture, at the anterior fontanelle, and upon the mastoid process of the temporal bone. Dermoids have been found within the cranial cavity, and by perforation of the parietal bone presented upon the outer surface of the skull. Upon the face besides, at the external or internal orbital processes, they are seen upon the median raphe of the nose or at the line of junction of the frontal with the nasal suture. When the dermoids take their origin from the median line of the body, they are due to a separation of a part of the epiblast during the process of closure of the branchial cysts. This formation is known by the term *enclavement*. They have also been seen beneath the hyoid bone, and a few have been observed along the margin of the sterno-mastoid muscle, with a deep attachment at the base of the skull from the styloid process of the temporal bone and also from the sheath of the carotid vessels.

Dermoid cysts are seen occasionally upon the front and median line of the thorax at the junction of the first and second portions of the sternum, also at the umbilicus and in the rectum. They also take their origin from the abdominal and thoracic cavities and from the spinal centres. They are seldom if ever seen upon the extremities of the body. A few have been reported as growing in the mammary and scapular regions. Dermoid cysts have been found in certain organs, as the lung, and within the tunica vaginalis of the testicle, and in some cases surrounded by the parenchyma of the gland.

Finally, dermoid cysts have taken their origin from the peritoneum and omentum. In these situations an ovarian dermoid has probably ruptured and some of its contents have been implanted upon the parts, and a secondary dermoid cyst has developed.

Dermoid cysts are essentially benign, but occasionally they attain such size about the age of puberty as to require surgical interference. The size may be due to a slow accumulation of the secretion from the glands and the walls of the cyst. In rare cases the important clinical fact must not be lost sight of that a dermoid cyst may become the starting-point of a sarcoma or carcinoma.

Dermoids may be divided most conveniently according to the classification of Sutton, whose classical work on tumors deserves the closest study, and to which the writer acknowledges the valuable aid afforded him in the preparation of this article. Sutton divided dermoids into four different groups: 1, the sequestration dermoids; 2, tubulo-dermoids; 3, ovarian dermoids; and 4, dermoid patches.

THE SEQUESTRATION DERMOIDS are situated in the median raphe of the trunk, extending from the glabella downward to the sternum and umbilicus, through the scrotum and penis in the male, and upward and backward along the central line of the coccyx and vertebra to the ligamentum nuchæ, and over the vertex of the skull to the glabella.

Dermoids are found less frequently along the median line of the back than upon the front of the body. They must not be mistaken for cases of spina bifida. Sequestration dermoids are found in the testicle, in the inguinal canal, also upon the sternum, and in a few cases within the thorax growing from the pericardium. They are seen upon the face at the inner and outer angular processes; upon the sulcus at the side of the

nose; upon the cheek; and occasionally in the pharynx in the form of a pedunculated tumor growing from the palatine arch; and also upon the side of the face, and known as mandibular tubercles. The dermoid may also take its origin from within the cranial cavity and perforate the skull.

THE TUBULO-DERMOID is a tumor situated in one of the canals which normally close after birth; the branchial clefts and the thyro-glossal duct are among the most conspicuous.

Dermoid cysts are found in connection with branchial cysts. The origin of these cysts is fully described in the article on the Surgery of the Neck. It is sufficient in this connection to state that these clefts become the seat of dermoid cysts. They may open upon the side of the neck or be closed by a thin piece of skin or cartilage. From the pharynx sometimes a diverticulum exists which opens into a pouch upon the lateral side of the neck, terminating in a fluid sac. The presence of the diverticulum often gives rise to much discomfort, since food and liquid often fall into the cyst during the act of deglutition.

Dermoid cysts of the thyro-glossal duct are observed. The thyroid gland develops by three separate segments—the two lateral lobes and the isthmus which takes its origin from the anterior wall of the pharynx of the embryo. In the early life of the fœtus the duct extends up to the dorsum of the tongue, but after the hyoid bone is developed the duct is divided into an upper and a lower segment, the former of which is called the lingual duct, and the latter the thyroid duct. If these ducts are not obliterated at birth, they may subsequently give rise to the formation of cysts.

The lingual dermoid is found in connection with the unobliterated duct, and is situated in the interspace between the genio-hyoglossus and the genio-hyoid muscle. The lingual dermoid is often mistaken for ranula. The cyst forms a swelling upon the floor of the mouth, and if large the tumor is visible under the chin. In the lingual dermoid a pultaceous mass is found consisting of fat, hair, epithelial cells, cholesterin, and mucus (Fig. 48). The walls of the cyst itself are formed of fibrous tissue. The inner surface of the cyst is covered by pavement epithelium. The duct below the hyoid bone may remain patent, and give rise to a cervical fistula which is situated in the median line of this part of the neck. This canal may open upon the median line of the neck just below the cricoid cartilage. Raymond Johnson has called attention to the important clinical fact that the median cervical sinus usually follows a cervical swelling which antedated the cyst.

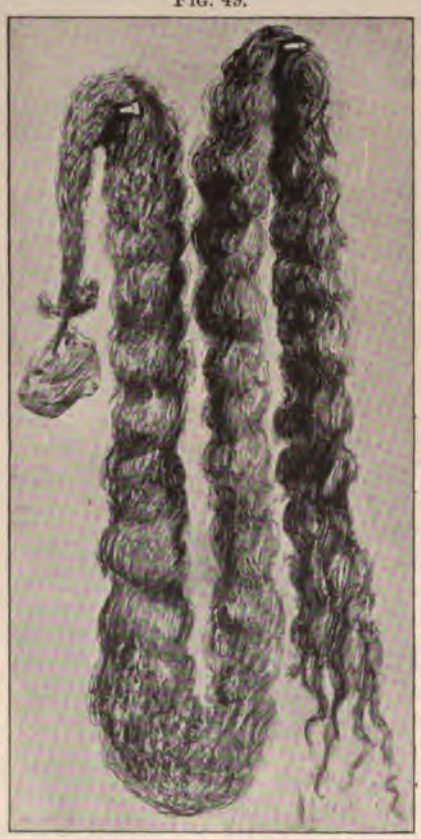
FIG. 48.

Large lingual dermoid protruding from the mouth (Gray).

The accessory thyroids may also give rise to dermoid cysts. These accessory glands may be found in the isthmus of the thyroid, in which case the term "median accessory thyroid" is applied, or upon the side and involve the lateral lobes, and to this the term "lateral accessory thyroid" has been given. In connection with the infundibulum and pituitary body there is a duct which normally should close, but may remain open. This duct lies in close juxtaposition to a blind sac known as the pouch of Rathke. In these ducts dermoids may develop.

RECTAL DERMOIDS when found growing from the mucous membrane of the canal and hanging from a pedicle are called "intrarectal dermoids," in contrast with those growing in the interspace between the rectum and the interior surface of the sacrum, to which the term "post-rectal dermoid" has been applied. The post-rectal dermoids and the sacro-coccygeal tumors are supposed to arise from the post-anal gut in the embryo.

FIG. 49.

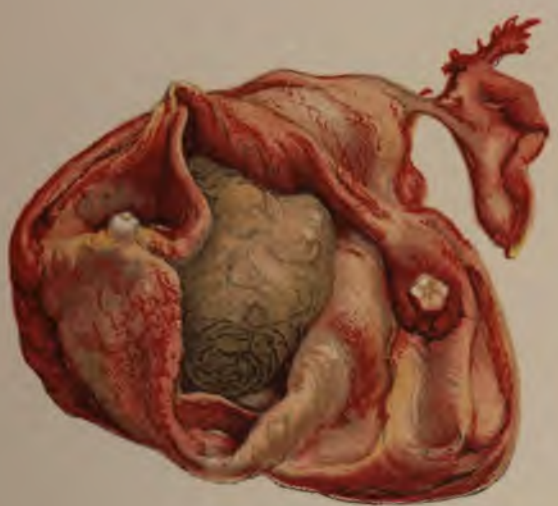


Switch of hair, five and a half feet long, from dermoid cyst (Mundé).

THE OVARIAN DERMOID (Plate II.) is unique in many particulars. The hair in an ovarian dermoid is long, since the strands of hair have been observed five and a half feet in length (Fig. 49). The teeth are large and numerous, and several hundred have been found in a single cyst. The glands are well developed, and in one case a mammary gland was found. Another peculiarity of the ovarian dermoid is that it may be an acquired and not a congenital cyst. The origin of the ovarian dermoid is from the epithelium of the ovarian follicles. The discussion of ovarian dermoid is given in full in the article on Diseases of the Ovary.

The **treatment** of dermoid cyst consists of complete and thorough excision, since any vestige left behind will form the nucleus of a new post-natal dermoid. The cyst should be extirpated, if possible, without rupturing the sac, in order to secure safety to the patient during the operation, especially if connected with the ovary, and also to prevent recurrence. The technique of the operation of removal of a dermoid cyst of the ovary is fully described in the article on the Surgery of the Ovary. Under no circumstances should a dermoid cyst ever be tapped or injected with any fluid to excite adhesive inflammation.

PLATE II.



Dermoid Cyst of the Ovary.

TERATOMA (*τέρας*, monster) is an anomalous tumor which consists of a heterogeneous mass of fœtal structures and tissues (Fig. 50).

In considering tumors thus far, those have been described which take their origin from cells which are derived from the epiblast, the hypoblast, and the mesoblast. The teratoma, on the other hand, takes its origin from two or all three of the germinal layers. The teratoma, therefore, is made up of several tissues of several organs or systems of organs in certain places where these structures are foreign. In other words, a teratoma is a congenital product, and is never derived from a matrix which is developed after birth. The teratoma is a congenital tumor, and is the result of perversion of normal growth or the inclusion of tissues by displacement in the fœtus.

The tumor may be composed of fragments and various tissues of the undeveloped fœtus. The mass is united to a normally-developed fœtus, and the two are derived from a double embryo contained in a single ovum. When the embryos are normally developed twins are the result, and they may be entirely distinct or conjoined. If the latter is the case, the normal fœtus is called an autosite and the imperfectly developed one a parasitic fœtus (Fig. 51). The autosite requires no description, but the parasitic fœtus or the teratoma is the part to which attention is directed.

FIG. 50.

Teratoma (Wood Museum).

FIG. 51.

Autosite and parasitic fœtus (Wood Museum).

The teratoma has been sometimes termed a mixed dermoid, a name that adds no special significance. The teratoma may present in the form of a conglomerate tumor or mass which springs from the sacrum or the thorax, or even may have an intra-abdominal origin. In one case a teratoma has been observed in the orbital cavity.

It hardly seems pertinent in connection with teratoma to discuss the question of twins, either separate or conjoined, or to speak of supernumerary extremities. These are subjects beyond the province of the subject of Teratoma.

The composition of a true teratoma is complex, heterogeneous, and unique. The mass is formed of bones, notably the vertebræ, integument, fingers, and toes, sections of the intestine, or pieces of liver.

If the teratoma springs from the lower part of the trunk, the parts are duplicated: for example, there will be a second pelvis imperfectly developed, with perhaps a few vertebræ, and from this limbs may project. When the teratoma affects this part of the trunk it is called posterior dichotomy. If the teratoma affects the anterior surface of the body instead of the posterior, the term anterior dichotomy is applied. This condition is observed in double-headed monsters. In some cases the teratoma involves, besides the head, a part of the chest, and forearms

FIG. 52.

External view of congenital sacro-coccygeal adenoma, or thyroid dermoid, in a male, showing tumor before operation and patient's method of concealing the growth (Francis H. Markoe).

are then duplicated in a similar manner as described in connection with the lower limbs.

Teratoma also includes the acardiac fœtus, and in fact to this condition the term "teratoma" is more specifically applied. The acardiac fœtus, as its name implies, is one which has no heart of its own, but

derives its nourishment from the autosite. The acardiac fœtus is never found singly, but always in connection with a plural birth.

The treatment of teratoma by operative interference has been most unsatisfactory. The parasitic fœtus cannot be removed from the autosite without endangering the life of the latter. In a few cases the operation has proved successful, but only where the teratoma was small and in a part accessible to the surgeon. The shock and hemorrhage usually cause a fatal result.

SACRO-COCCYGEAL tumors are found in the region of the sacrum and coccyx. They are usually cystic in character, but may be fatty or fibrous, or even composed of fœtal remains, in which case they are dermoids.

They may be cystic or they may be caudal excrescences. The cystic tumor is often congenital, in which case it springs from the spinal mem-

FIG. 53.

Interior view of same sacro-coccygeal adenoma or thyroid dermoid (Francis H. Markoe).

branes. If the spinal canal is closed, these sacral tumors may take their origin from the interior of the pelvic cavity, and by pressure push the coccyx backward and the rectum forward, and emerge along the edge of the gluteal maximus muscle. If the cystic tumor comes from the spinal membranes, there is great risk in any operative interference, since convulsions or some other serious disturbance is likely to ensue (Figs. 52, 53).

If the tumor is lipomatous or fibrous and not connected with the spinal meninges, the operation is not attended with great risk.

The surgeon should, if possible, ascertain whether the tumor has spinal connections or not, for the prognosis depends more upon the connections of the tumor than it does upon the origin of the growth. It was formerly supposed if a sacral tumor had intraperitoneal connections that, owing to diffuse cellular inflammation, it was unwise to attempt its removal. Since antiseptic surgery has been introduced this objection has been overcome. The sacral tumor with rectal, bladder, or spinal connections can be usually removed with safety. The presence of the tumor in the median line indicates the spinal origin of the cyst, and this diagnosis can be confirmed by a chemical examination of the fluid, which can be obtained by puncture with a hypodermic needle which has been thoroughly sterilized before introduction.

If the tumor has any connection with the rectum or bladder, the fluid is often discharged with the urine or fæces. Impulse on coughing in a sacral tumor generally denotes a connection with the intestine, although there are cases reported in which a sacral cyst had connections with the intestine and this sign was not present. Exploratory puncture often makes certain the precise nature of the cyst.

The **treatment** of sacral tumors consists in an antiseptic excision of the entire sac with suture of any organ or viscus injured. The peritoneum can be stitched so as to close the cavity, as in other operations upon these parts. Puncture and injection of iodine are only mentioned to be condemned. The fact must not be lost sight of that removal of these dermoid cysts is indicated, because they often undergo epitheliomatous degeneration.

The accompanying illustration (Fig. 53) represents a most interesting case which occurred in the practice of Dr. F. H. Markoe, to whom the writer is indebted for this contribution.

Phantom tumors are not, strictly speaking, to be classed with neoplasms. A reference is made in this connection in order not to omit a condition which might be mistaken for a tumor. They are caused by a spastic contraction of the abdominal muscles, notably the rectus abdominis. They are often observed in connection with hysteria. They have also been observed as a result of an accumulation of gas in the intestine or to an excess of fat in the omentum. The condition is often most deceptive, and abdominal section has been performed under the supposition that the swelling was an ovarian cyst.

In case of a doubt the **diagnosis** can be made certain by the administration of an anæsthetic, in which case the tumefaction will entirely disappear. The writer has seen several cases in which the patient was able to hold her breath and produce a tumor of the abdomen simulating an ovarian tumor to such an extent that the question of operation was considered; the administration of an anæsthetic disclosed the true nature of the tumor on the ground that the tumor was ovarian in character.

THE MICROSCOPICAL STRUCTURE OF TUMORS.

By EDWARD K. DUNHAM, M. D.

Every surgeon should know enough of the simple technique of preparing sections for the microscope to be able to so preserve the tissues he removes from the body at an operation as to fit them for careful and satisfactory microscopical study. When tissues have been severed from their vital connections, their constituent cells are deprived of nourishment and rapidly undergo changes which may within a very short time obliterate characteristics which it would be of great practical importance to preserve. This is notably so in cases where the cells of a tumor are proliferating.

Cell-proliferation is first revealed by a series of changes in the structure of the nucleus, visible in well-preserved specimens, which are collectively designated by the term "karyokinesis," and which end in the division of the nucleus into two or more "daughter" nuclei. After the division of the nucleus, the body (protoplasm) of the cell usually divides in such a way as to include one of the daughter nuclei in each division of the cell-body. During karyokinesis the mother nucleus loses its vesicular character, and those portions of its substance which possess an affinity for nuclear stains (the "chromatin") come together to form one or more threads. These threads then go through a complex, orderly series of divisions, during which the threads or their fragments are arranged in a succession of pretty well-defined figures (mitoses), the final outcome being the formation of two vesicular daughter nuclei closely resembling the mother nucleus.

The preservation of these mitoses (nuclear figures) is of importance to the surgeon, because by their presence he is able to learn that the cells in which they are situated were in the act of dividing at the time he removed the tissues. These figures either disappear or lose distinctness very soon after a tissue containing them is deprived of nourishment, unless pains be taken to bring about a sudden death with a coagulation which prevents further change. This sudden killing, associated with coagulation of the tissue-elements, the histologist calls "*fixing*." It is to be distinguished from a mere "hardening" of the tissue, which designates only an increase of its consistency, accompanied, it is true, by coagulation of some of the tissue-elements, but a coagulation taking place so slowly, irregularly, or incompletely that the details described above are obscured or lost.

"Fixation" of the tissues is usually brought about by immersing small portions of the still living tissues in liquids, called "*fixing solutions*," which have a rapidly fatal and coagulating influence on the tissue-elements. It is exceedingly desirable that the surgeon should become familiar with the use of some convenient fixing solution, and that he should carry one or more small bottles containing the solution with him to his operations, and acquire the habit of dropping a few bits of the tumors, lymphatic glands, or other tissues he removes into the bottles

while they are still at the body-temperature.[1] Vaseline bottles, holding two ounces and provided with good corks, serve this purpose perfectly. If every surgeon would take this trouble, material suitable for study by the present advanced methods of microscopy would always be available to furnish accurate knowledge of the structural details of the growth.

Such an enlightened mode of reserving material for microscopical examination possesses the further advantage over the usual negligent practice that it saves time in reaching a microscopical confirmation of the diagnosis in cases where nothing more than that is desired by the surgeon. It would also not infrequently aid materially in defining the prognosis of the case.

It appears fitting, in view of the foregoing considerations, to include in this section a brief summary of the methods in most common use for the preparation of thin tissue-sections for microscopical examination. They usually include the following steps:

1. Fixation.
2. Hardening.
3. Imbedding.
4. Cutting.
5. Staining.
6. Mounting.

The first two of these steps alone require present consideration.[2]

The object of fixation has already been sufficiently elucidated. It remains to give practical suggestions in enough detail to answer the purpose of the surgeon. Alcohol is always used to complete the hardening.

Many of the best fixing solutions will not keep well, and must, in consequence, be prepared shortly before they are used: this is the case with those containing osmic acid, which cannot, therefore, be commended for use by the general surgeon. Among those which will keep are absolute alcohol and various solutions of corrosive sublimate, which will answer all requirements.

I. Absolute alcohol should not contain more than about $\frac{1}{2}$ per cent. of water. As alcohol of this strength has a very great affinity for water, it is difficult to obtain it or to keep it in this concentration unless it be bought in the original package sealed by the maker.[3] If it is not preserved in bottles with tightly-fitting corks of close texture, it rapidly absorbs moisture from the air and loses its virtues as a fixing agent.

Absolute alcohol differs, in its action upon fresh tissues from what is usually styled "pure alcohol" (95 per cent.) in that it quickly coagulates the tissues without macerating them. This coagulation is so rapid that hardly any shrinkage of the tissues takes place, provided the pieces that are thrown into the alcohol be small. They should not measure more a quarter of an inch in thickness. If much larger than this, the water in the tissues themselves, which amounts to about 75 per cent. of their

[1] It would be a very simple matter to instruct an assistant or some bystander to do this, care being taken to have the pieces small—not more than one-quarter of an inch thick—and to have them thoroughly immersed in at least four or five times their volume of the fixing solution.

[2] Details not given in this section the reader will find fully considered in special works on the subject.

[3] That prepared by E. R. Squibb & Sons, Brooklyn, N. Y., can be confidently recommended. It is put up in bottles containing about a pint.

weight, is sufficient to dilute the alcohol and to impair its efficiency as a fixative. The quantity of alcohol used should be not less than twenty-five times the volume of the tissue immersed in it.

The following specific directions are the outcome of practical experience: Crowd a wad of white writing paper into a two-ounce vaselin bottle, so that it loosely fills the lower half of the bottle. Fill nearly to the shoulder with good absolute alcohol and cork tightly with a taper cork of the best quality.[1]

At the operation select bits of the growth from representative parts of the tumor—*e. g.* from near the centre and from various points at the periphery, including the margin—and drop them at once into the absolute alcohol, taking pains to preserve the identity of the different bits. Lymph-glands, if larger than a small bean, should be incised before placing them in the alcohol. The pieces made to include the margin of the growth should be slices about a quarter of an inch thick, perpendicular to the margin of the tumor and extending well into the growth in one direction, and in the opposite direction extending peripherally so as to include the surface of the incision made by the surgeon's knife when removing the tumor. The specimens may be kept in these bottles of alcohol for an indefinite length of time, provided the corks fit tightly, or they may be used for the preparation of sections within twenty-four hours, as the alcohol not only fixes, but hardens, the tissues.

If alcohol of requisite strength is obtainable, the foregoing method yields the quickest results with the least trouble to the surgeon. But the preservation of the tissues in a condition closely resembling that during life is less perfect than if the following slightly more complicated method be employed:

II. Zenker's fixing solution was proposed by K. Zenker in 1894,[2] and has the following composition:

Distilled water	100.0
Mercuric chloride	5.0
Potassium dichromate	2.5
Sodium sulphate	1.0
Glacial acetic acid	5.0

This solution keeps pretty well, but if it is desired to prepare a quantity to be kept in stock, it is advisable to leave out the acetic acid, adding it at the time the vaselin bottles are filled prior to an operation.

The pieces of tissue, which must be small, should be left in the fluid for twenty-four to forty-eight hours. They should then be washed in running water for about six hours, and then hardened in alcohol. The best way to do this is to use alcohol of various strengths. First put the washed tissue into 50 per cent. alcohol for about twenty-four hours, then in 70 per cent. for forty-eight hours, and then in 90 per cent. alcohol, to which enough tincture of iodine has been added to give it a deep sherry color.

This is a slow method, but where the tissues are not required for

[1] The object of placing the paper in the bottle is to keep the tissues, when immersed in the alcohol, at some distance from the bottom of the bottle. This favors a rapid penetration of the alcohol, as the water which leaves the specimen sinks to the bottom.

[2] *Münchener med. Wochenschrift*, Bd. 41, p. 532.

immediate diagnosis it can be commended as an excellent preservative of the microscopical details of the tissues.

III. A far less valuable fixing solution may be quickly improvized by saturating water with corrosive sublimate.[1] Pieces of tissue, which must be small, may remain in this for some time—one to several days—and then be thrown into 70 or 80 per cent. alcohol, in which they may be kept.

IV. Finally, an excellent fixing agent is furnished by formol or formaline (formic aldehyde), which may be used in 5 or 10 per cent. solution in water.[2] It acts quickly, rendering the tissues susceptible of yielding good sections within a few hours. Where convenience and despatch are most desirable this method is specially recommended. After treatment with formaline the tissues are to be further hardened in alcohol, or they may be sectioned with a freezing microtome without further preparation.

Before proceeding to a description of the structure of the individual neoplasmata a few statements regarding this interesting group of tissues appear essential for a clear expression of the writer's views on the subject. It is not necessary in this section to further discuss any system of classification of tumors.

The process resulting in that new-formation of tissue which constitutes a neoplasm is analogous to that which takes place during the physiological development of the tissues: the cells multiply by division, and then, according to the nature of the growth, produce more or less intercellular material. The nature of the cells and of the intercellular substances springing from those cells determines the character of the neoplasm.

But tumors differ in two respects from physiological new-formations of the tissues: First, they do not begin as any considerable mass of embryonic tissue which then progressively develops into more and more highly differentiated structures; and, second, they do not arise in response to an increased demand upon the physiological activities of the tissues from which they spring.

The former of these characteristics differentiates tumors from inflammatory hyperplasias; the second differentiates them from a considerable group of hypertrophies. The writer would also exclude from the neoplasmata those tumors which are the result of mechanical causes, such as retention-cysts, and those due to parasites, such as echinococcus cysts and the infective granulomata, the latter being inflammations in which the natural course of the inflammatory hyperplasia is modified by the persistent influence of the parasitic cause.

Certain of the neoplasmata present characters which are grouped under the term "malignancy." These characters are—1. A marked tendency to recur after removal; 2. A tendency toward metastasis; and 3. Among some of the malignant neoplasmata a tendency toward

[1] This solution may be most quickly prepared by heating water with so much corrosive sublimate that some of the latter remains undissolved. After cooling, the excess of bichloride will crystallize out of the liquid, leaving a clear saturated solution which can be poured off and is then ready for use.

[2] The formol, formalin, or formaldehyde of commerce is usually a 40 per cent. aqueous solution of formic aldehyde.

the impairment of the general health beyond that tax upon the system involved in the nourishment of the new tissue. This impairment of the general health is designated by the word "cachexia."

An explanation of these clinical characteristics of the malignant neoplasmata is furnished, to a certain extent, by their structure. Those neoplasms which are not malignant are composed of tissues in which, as the cells multiply, an intercellular substance is produced in sufficient quantity to imprison the cells. In the malignant tumors the intercellular substances are reduced to a minimum, the cells being so loosely held by it that they have an opportunity to infiltrate the tissues surrounding the neoplasm, whence they may find their way into the lumina of the blood or lymphatic vessels. When they have gained access to the blood or lymph the cells of the tumor are carried to other parts of the body, where they either die or may continue their proliferation, producing a secondary or metastatic tumor.

The fact that the cells of the malignant neoplasm are not sufficiently confined by the intercellular substances to prevent their dissemination, but are permitted to permeate the surrounding tissues, is of great clinical significance. Such cells may be present in the tissues at a considerable distance from the apparent margin of the tumor from which they sprang. If such be the case and the tumor be removed without the excision of these infiltrated tissues, a "recurrence" of the tumor near the scar left by the operation depends merely upon the retention of life by the infiltrating cells of the neoplasm. The "recurrent" nodules in such cases are simply the result of continued growth of those portions of the neoplastic tissues which have not been removed or destroyed by the surgical intervention.

The cachectic condition is most marked in cases of carcinoma, and is probably due, at least in part, to the production of substances by the cells of the neoplasm, which after absorption exert an injurious effect upon the general nutrition of the body. The essentially active cells of the carcinomata are epithelial, and, since epithelium in its normal situations is one of the tissues displaying the greatest metabolic or chemical activity, it is reasonable to believe that in the abnormal site which it occupies in a cancer it retains these intracellular activities, without the opportunity to discharge the products of those activities upon a free surface. They must, therefore, be absorbed. In these days, when it seems probable that the "internal secretion" of glands has some influence upon the general welfare of the body, the foregoing hypothesis relative to the causation of the cancerous cachexia appears at least plausible.

The tissues of tumors are liable to the same morbid processes which may affect other tissues. They may become the seat of necrosis, of atrophy, of degenerations, of infiltrations, or of inflammation, or even of neoplasmata. Necrosis of a portion of a tumor or the degeneration of its component cells, followed by disintegration and absorption, may lead to a softening of the tumor. This is not infrequent in the malignant tumors.

Tumors may mechanically affect the nutrition of the surrounding tissues, causing their atrophy, necrosis, or ulceration.

While, in structure, the tissues of a tumor correspond to tissues normally found in the body either during fœtal life or in after years, yet

they present anomalies in their arrangement, in the relative proportions of their constituents, and in the perfection of the differentiation exhibited by their elements which correspond to their lack of function and utility to the general organism. Because of these slight departures from the normal tissue-types the tissues of neoplasmata are described as "atypical."

I. Tumors arising from the Connective Tissues.

These tumors spring from the cells of fibrous tissue, cartilage, or bone, those cells undergoing a sort of rejuvenescence, multiplying and causing the production of more or less intercellular substance. The nature of this intercellular substance may correspond to that originally between the cells of the tissue from which the growth sprang, or it may resemble the intercellular substance of any of the other varieties of tissue belonging to the group of connective tissues. A given neoplasm of this class may, therefore, be composed of tissue very closely resembling the original tissue from which it sprang, or the cells which produce the neoplasm may depart from the specialized character of the parent cells and occasion a production of a different but related tissue. In extreme cases this departure may amount to a reversion to the embryonic type, in which case the cells manifest their activity by an unlimited proliferation, without the elaboration of any of the intercellular substances characterizing the fully-differentiated tissues of this group. In this case the resulting neoplasm is malignant (*vide supra*, p. 120), and is called a sarcoma. The differentiation of the tissues of the neoplasm may not take the same direction in all parts of the tumor. When this is the case mixed or composite tumors result. Such tumors not infrequently contain portions in which all such differentiation is absent. In that case they contain a sarcomatous constituent, and, inasmuch as this is clinically their most important feature, it is usually given greatest prominence in the titles by which the tumors are designated.

These general considerations will make it evident that, developing from the cells of any connective tissue, a whole series of tissues belonging to the same group may arise, merging into each other by almost imperceptible graduations, and forming, in the aggregate, a single nodule or a tumor of very complex structure.

In the majority of connective-tissue tumors, however, the whole neoplasm consists of but one tissue, associated with the vascular supply necessary for its nutrition, supported by a varying amount of fibrous tissue. A brief description of these tumors of simple structure will suffice:

1. *Inoma or Fibroma.*—Tumors composed of white fibrous tissue may be either hard or soft. In the hard variety the fibrous tissue resembles in its minute structure that normally present in tendons, ligaments, and aponeuroses, though it may even exceed these in the density of the fibrous intercellular substance and in the sparseness of the cellular elements. The tumor frequently appears encapsulated, because the tissues surrounding it become compressed, their soft parts atrophied, and their fibrous interstitial tissue condensed as the tumor enlarges. In the soft variety (fibroma molluscum) the fibrous tissue of

the neoplasm simulates that normally constituting areolar tissue, the spaces between the loosely-interlacing bands of fibres being filled with lymph or with a mucoid fluid.

Inomata may be circumscribed, as is implied in the foregoing description, or they may be diffuse. In the former case they start from only a few points of proliferation, and as they enlarge they separate and compress the tissues pre-existent at the site of the growth. In the latter case they appear to spring from a general proliferation of the fibrous interstitial tissue of an organ, the parenchymatous elements of which either undergo atrophy from pressure or adapt themselves with more or less structural modification to their new environments.

Fibrous tissue is a frequent constituent of composite tumors, the most common of which are adeno-fibroma and fibro-sarcoma.

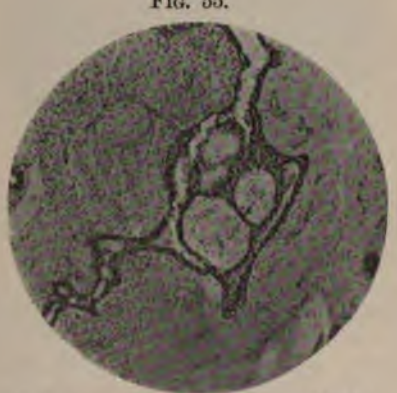
Inomata vary greatly in respect to their vascular supply. In the harder varieties the blood-vessels barely suffice to maintain the nourishment of the neoplasm, while from that minimum the vascularity in different growths may increase relatively to the fibrous tissue until the maximum is reached in the case of tumors which consist chiefly of blood-vessels, with barely enough intervening fibrous tissue to lend them support (angeioma). The same relations exist with respect to the lymphatic vessels. Where they reach their maximum relative development they constitute the great bulk of the growth (lymphangeioma).

Fig. 54 is a photo-micrograph of a small diffuse inoma of the kidney, situated in one of the pyramids of that organ. In this case the parenchyma (renal tubules) of the kidney has suffered atrophy, although traces of it are to be seen imbedded in the new-formed fibrous tissue. The latter is dense, and reveals its atypical character in the irregular dis-

FIG. 54.

Inoma of the kidney (× 50).

FIG. 55.



Intracanalicular adeno-fibroma of breast (× 50).

tribution of the cells (the nuclei of which appear as dark spots) and the orderless arrangement of the fibres. In one place a double row of round nuclei reveals the presence of an atrophied renal tubule of which the epithelial lining has not yet entirely disappeared.

Fig. 55 shows an intracanalicular adeno-fibroma of breast from an unmarried woman thirty-two years of age—a small tumor first noticed

two months before its removal. The section passes through three of the fibrous ingrowths lying in a cystic dilatation of a glandular alveolus. Their connection with the fibrous tissue surrounding the alveolus is not included in the section. The number of cells in the fibrous tissue of the section varies considerably in different parts. Where they are more abundant they probably indicate a more rapid growth. In two of the ingrowths vessels are shown in oblique section. A few similar vessels can be seen in the surrounding fibrous tissue. This specimen illustrates the possible adaptation of the parenchyma of an organ to the new environments occasioned by the development of a neoplasm. Because of the participation of the glandular elements in the production of these tumors they are usually called adeno-fibromata, and to distinguish them from similar growths in which there are no intra-alveolar fibrous masses (see Fig. 56) they receive the descriptive title intracanalicular adeno-fibroma or cystoma papilliferum.

In Fig. 56 is shown an adeno-fibroma of the breast from a married woman aged thirty-nine. It was first noticed as a small, hard nodule near the nipple two years before its removal. It was of slow growth. The patient recalls having bruised the spot nine years before the date of operation. The growth gave no pain and was not troublesome. The section reveals a rather dense, slightly vascularized fibrous tissue enclos-

FIG. 56.

Adeno-fibroma of breast (× 50).

FIG. 57.

Intracanalicular adeno-papilloma of breast (× 50).

ing glandular alveoli, some of which have undergone cystic dilatation. It will be noticed that around each alveolus there is a distinct but thin layer of fibrous tissue which appears to confine the epithelium.

The fibrous growths projecting into the cystic alveoli of these tumors may be less dense than in the case first described, approximating areolar tissue in structure and presenting the appearance of villi which project into the cysts and sometimes display a complex branching (Fig. 57).

Fig. 57 illustrates a case of intracanalicular adeno-papilloma of breast from a woman aged twenty-seven. The growth was first noticed about one and a half years before its removal. It grew slowly, and gave no pain until about two months before the operation, when the increase in size became more rapid and the growth gave pain. The growth at the

time of operation was one and a quarter inches in diameter and contained cavities in which there were some fluid and soft masses of tissue. The section displays a complicated structure in which fibrous and glandular proliferations are about equally evident.

The preceding tumors (Figs. 56 and 57) are usually classed among the epithelial neoplasms, and in those cases in which the epithelial proliferation appears dominant this is no doubt proper, but in those cases in which the epithelium simply proliferates sufficiently to clothe surfaces of the growing fibrous tissue the tumor should be regarded as one of interstitial type. They are benign, but may acquire a malignant character in either of two directions: a sarcoma may develop in the fibrous tissues or a carcinoma may develop from the epithelium.

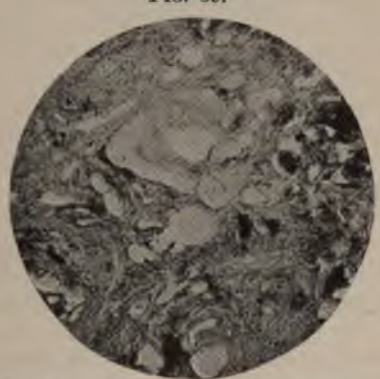
Such developments of malignant character are sometimes inadvertently designated as "degenerations." They are not degenerations in a pathological sense, but merely a more pronounced reversion toward a primitive stage of tissue-production.

In Fig. 58 is shown a hæmangeioma of the spleen. The history of the growth is not known. (Specimen from an autopsy.) The lumina

FIG. 58.

Hæmangeioma of the spleen (× 50).

FIG. 59.



Lymphangeioma of the subcutaneous tissue (× 15).

of the blood-vessels are partially filled with fibrin and the remains of blood-corpuscles. Structures closely resembling this may be produced by the dilatation of the blood-vessels of an organ associated with an atrophy of the structures lying between the vessels—*e. g.* angeioma of the liver.

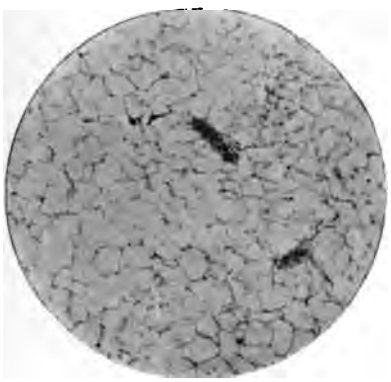
Fig. 59 shows a lymphangeioma of the subcutaneous tissue. The lymphatic vessels are dilated and scattered irregularly through the rather dense fibrous tissue which surrounds them. Coagulated lymph nearly fills the vessels.

2. *Lipoma.*—Tumors composed mostly of adipose tissue are closely related to the soft inomata. The fat-cells of the adipose tissue are connective-tissue cells which have become largely infiltrated with fat. It is therefore not surprising to find composite tumors in which adipose tissue is found associated with other forms of connective tissue: fibro-lipoma, myxo-lipoma, sarcoma lipomatosum are examples of such com-

binations. The majority of lipomata spring from pre-existing adipose tissue, and are composed entirely of fat, associated with enough fibrous tissue to give support to its lobules and the nutrient vessels. The nature of the tissues precludes the occurrence of metastases.

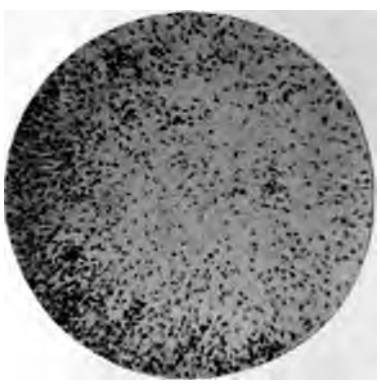
Fig. 60 illustrates a case of lipoma of the deltoid region from a man aged thirty. The growth began about five years before it was removed.

FIG. 60.



Lipoma of the deltoid regon (× 50).

FIG. 61.



Myxo-sarcoma of the femur (× 50).

The section is composed of fat in which two vessels are shown in oblique section.

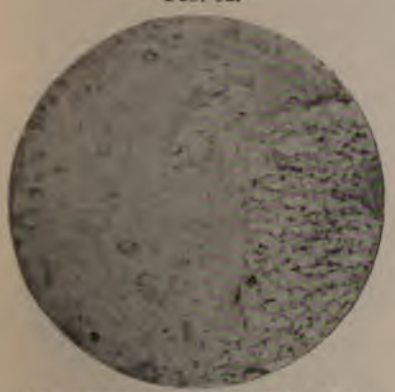
3. *Myxoma* is a term given to neoplastic mucous tissue consisting of cells provided with delicate processes which unite to form a network filled with a gelatinous substance or viscous fluid. This tissue never forms the whole bulk of the tumor, but is a not infrequent constituent of composite tumors, the most common of which are fibro-myxoma, lipo-myxoma, chondro-myxoma, and myxo-sarcoma.

In Fig. 61 is illustrated a section of myxo-sarcoma of the femur. To the right are shown the cells of the mucous tissue with their anastomosing processes. The intercellular substance is here homogeneous and transparent. To the left the mucous tissue gradually merges into a more highly cellular tissue, in which the amount of intercellular substance is much less than to the left. This illustrates the transition between mucous and sarcomatous tissues.

4. *Chondroma.*—Any variety of cartilage may enter into the formation of a tumor, but the hyaline is most frequently met with in neoplasmata. It usually occurs in lobular form, the lobules being separated by bands of fibrous tissue, but occasionally the cartilage is arranged in such a manner as to suggest bone deprived of its earthy constituents (osteoid enchondroma). The atypical character of the tissue is betrayed by irregularities in the arrangement, size, and distribution of the cells, and by variations within the same growth in the character of the intercellular substance. Cartilage is found in composite tumors, of which osteochondroma and chondro-sarcoma are examples. In the parotid gland and the testis it is frequently associated with other forms of connective tissue and with epithelial new-growth forming mixed tumors of very complex structure.

Myxo-chondroma of the parotid gland is shown in Fig. 62. The chief mass of the tumor is composed of a somewhat atypical hyaline

FIG. 62.



Myxo-chondroma of the parotid gland (× 50).

FIG. 63.

Osteoid chondroma of the lung (× 50).

cartilage, shown in the left half of the figure. To the right is a mucoid tissue, probably the result of mucous degeneration of the cartilage, but possibly developed simultaneously with the cartilage. In the former case the tumor should be regarded as a chondroma undergoing degeneration; in the latter case it is a true myxo-chondroma.

Fig. 63 shows a section of an osteoid chondroma of the lung, taken from a metastatic growth, and owing its susceptibility of metastasis to admixture with sarcoma. The tissue is composed chiefly of hyaline cartilage arranged in a way simulating the structure of cancellated bone. Spots will be noticed in which the nuclei of the cells are so close together that there can hardly be any intercellular substance between the cells in which they lie. This may be taken as indicative of the sarcomatous character of the tissue at those places.

5. *Osteoma.*—Bone may appear in tumors, in either compact form (osteoma durum) or in cancellated form (osteoma spongiosum). It usually springs from pre-existent bone, but may take its origin from some other variety of connective tissue. New-formed bone the result of inflammation (*e. g.* productive periostitis) should not be regarded as a tumor.

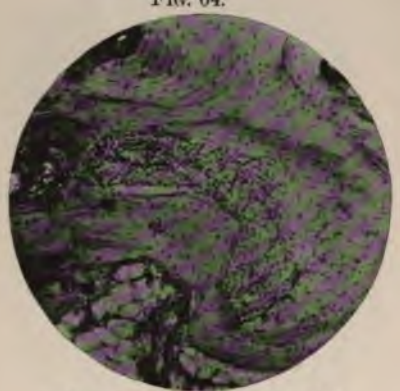
A pure osteoma is benign, but the bone in a neoplasm is not rarely associated with sarcoma (osteo-sarcoma), in which case the composite tumor possesses malignant qualities. Bone also sometimes occurs as a subordinate constituent in other composite tumors of connective-tissue origin.

The microscopic structure of the osseous tissue usually departs somewhat from the normal type. The arrangement and relative abundance of the tissue-elements or the character of the calcification may be atypical.

Fig. 64 shows an osteoma of the dura mater. The bone is of the compact variety, portions of four Haversian systems being included in the section. The thickness of the section rendered it difficult of photographic reproduction.

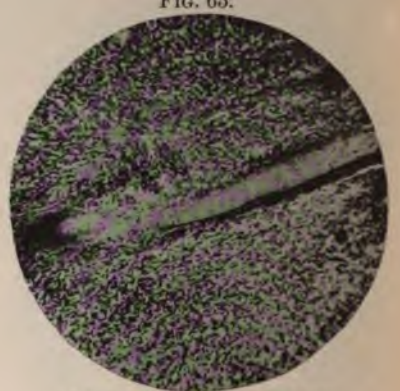
In Fig. 65 is shown an osteosarcoma of the jaw. The tumor was composed chiefly of spindle-celled sarcoma, in which there were plates of osseous tissue similar to those found in cancellous bone. The section

FIG. 64.



Osteoma of the dura mater (× 50).

FIG. 65.



Osteosarcoma of the jaw (× 50).

shows one such plate. Dark bands at the edges of the plate of bone are composed of cells closely packed together, to the activities of which the bone owes its origin.

6. *Neuroglioma.*[1]—This variety of tumor occurs in the central nervous system, and has for its prototype the normal neuroglia of the brain and the spinal cord. It is composed of cells the protoplasmic bodies of which are only a little larger than the nuclei they contain. These cells possess delicate processes which frequently branch, and which by their interlacing form a meshwork. Neurogliomata vary considerably in the compactness of structure which they present. They are not malignant, but may enter into the formation of composite tumor (neuroglio-sarcoma) in cases where the connective tissue surrounding the blood-vessels takes on a sarcomatous proliferation.

7. *Sarcoma.*—In the preceding short descriptions of the tumors springing from tissues included in the group of connective tissues constant mention has been made of composite tumors in which sarcoma was a constituent. A tumor may consist only of sarcoma—*i. e.* of embryonic connective tissue, by the elaboration of a pronounced and well-defined intercellular substance, which does not display any marked tendency to develop into any completely differentiated variety of connective tissue. These are the pure sarcomata. In other cases the sarcomatous tissue may show distinct evidences of a tendency to the development of tissues higher in order, and different tumors may show this to such an extent that it becomes difficult to determine whether they should be classed with the sarcomata or with highly cellular forms of benign growths. This tendency to differentiation is betrayed by the presence of intercel-

[1] The neuroglia is of epiblastic origin, and does not, therefore, belong to the group of connective tissues. The neurogliomata are considered in this place because they are unlike the other neoplasms which spring from epiblastic tissues, and are apparently frequently associated with new-growths springing from the true connective tissues of the central nervous system—*e. g.* gliosarcoma.

lular substances, and as these increase in amount and in compactness the chances of metastasis diminish and the tumor assumes a more benign character. The abundance, universality, and compactness of the intercellular substance may be therefore accepted as criteria by which to estimate the malignancy of a given sarcoma.

Those sarcomata which show distinct tendency to produce fibrous intercellular substances are called fibro-sarcomata; those in which the tendency is toward the formation of a mucoid intercellular substance are designated as myxo-sarcomata (Fig. 61). Other tendencies lead to the formation of osteosarcomata (Fig. 65), chondro-sarcomata, etc.

The pure sarcomata differ in the shape and size of their component cells.

A. *Small Round-celled Sarcoma.*—This is the least differentiated of the sarcomata; *i. e.* the cells show the least tendency to the production of a tissue of higher type either by changes in the cells themselves or by the production of a well-developed intercellular substance. The tissue consists of a mass of closely-aggregated round cells of small size, provided with vesicular nuclei, around which is a small amount of protoplasm. Between the cells is a very slight amount of intercellular substance in which delicate fibres may sometimes be detected. The tissue is vascularized by very thin-walled blood-vessels supported in some instances by a little fibrous tissue, but often appearing like gigantic capillaries, without other support than the surrounding tissue of the neoplasm itself. This fact may serve as an explanation of the frequent hemorrhages which occur in these tumors, and probably also of metastases that occur through the medium of the blood-current. In other cases the metastasis takes place because of an infiltration by the new growth of larger vessels lying near the site of the neoplasm.

Fig. 66 shows a small round-celled sarcoma of the neck from a man twenty-two years of age. Three months before the operation at which

FIG. 66.

Small round-celled sarcoma of the neck (× 50).

FIG. 67.

Small round-celled sarcoma. Same case as Fig. 66 (× 250).

this growth was removed the patient had an "abscess" under the jaw, which was lanced. The wound healed, but a lump was noticed at that time on the tongue. One month later this was removed. About five

weeks later a nodule appeared on the side of the neck which grew in three weeks to the size of a hen's egg. This was then removed, and is the growth from which this section was taken. The photograph is from a portion of a section containing a large blood-vessel, the walls of which are of extreme thinness. The numerous cracks in the specimen illustrate the fact that there is very little intercellular substance to hold the cells of the growth together. The history of the case emphasizes the malignancy of this form of tumor.

In Fig. 67 is shown a small round-celled sarcoma from same case as Fig. 66. The general character of the cells, the inconspicuous amount of the intercellular substance, the consequent looseness of structure, and the delicacy of the nutrient blood-vessels are illustrated by this photograph. Owing to the friability of the tissues, these sections were difficult of preparation and unsatisfactory for photographic reproduction.

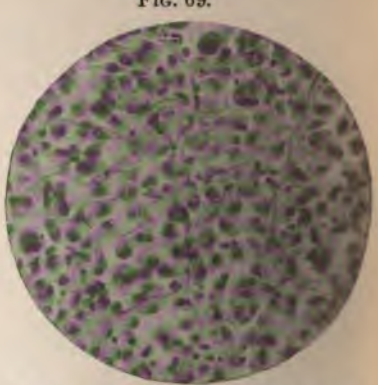
In Fig. 68 is shown a specimen of a round-celled sarcoma from the pelvis of a woman aged thirty, selected to illustrate the process of infiltration of the surrounding tissues by the sarcoma. The cells of the sarcoma, which are rather larger than those composing the preceding tumor, are shown lying between the fibrous bundles of the connective tissue situated at the periphery of the growth. As these cells proliferate the fibrous tissue lying between them is gradually absorbed. This section is suggestive of the mode in which metastasis through the lymphatic channels may be brought about.

B. *Lympho-sarcoma* is a variety of sarcoma closely resembling the small round-celled sarcoma in the character of its chief component cells.

FIG. 68.

Round-celled sarcoma of pelvis (× 250).

FIG. 69.



Large round-celled sarcoma of the tongue (× 250).

These lie in a delicate reticulum which is made up of processes proceeding from some of the cells and branching throughout the mass of the tumor. In this respect these growths resemble the structure of the neuroglio-sarcomata.

C. *Large Round-celled Sarcoma.*—In this variety of sarcoma the cells possess a considerable protoplasmic body, including from one to four vesicular nuclei. There is a more pronounced fibrous intercellular substance (stroma) than in the small round-celled sarcoma, and this

sometimes runs in strands through the tissue, giving it an alveolar appearance.

Fig. 69 shows a large round-celled sarcoma of the tongue from a man aged sixty-one. About eight months before the operation at which the growth was removed the patient bit his tongue on the side, causing a blister at the point where the growth subsequently appeared. This sore spot came in constant contact with carious teeth, and after three months began to grow hard, and from that time continuously increased in size, The growth was nearly spherical when removed and measured three-quarters of an inch in diameter.

The cells of this growth are larger than in the case of small round-celled sarcoma, and possess a distinct protoplasm in which from one to four nuclei are situated. There is very little intercellular substance, but a fine network of vascular fibrous tissue runs through the growth, giving the sections an alveolar appearance.

D. *Spindle-celled Sarcoma.*—In this variety of sarcoma the cells are spindle-shaped. They vary in size in different tumors. They are usually arranged in bundles in which the cells lie parallel to each other. These bundles interlace in various directions, frequently following the course of a blood-vessel which they envelop. The amount of intercellular substance, which is fibrous, varies greatly in different tumors or in different parts of the same tumor, and may be so abundant as to give the growth a fibrous character (fibro-sarcoma).

Spindle-celled sarcomata are less liable to produce metastases than the round-celled sarcomata.

Fig. 70 is a spindle-celled sarcoma from the pelvis of a woman aged forty-nine. It was first noticed three months before its removal. The

FIG. 70.

Spindle-shelled sarcoma of the pelvis (× 50).

FIG. 71.

Fibro-sarcoma of soft palate (× 250).

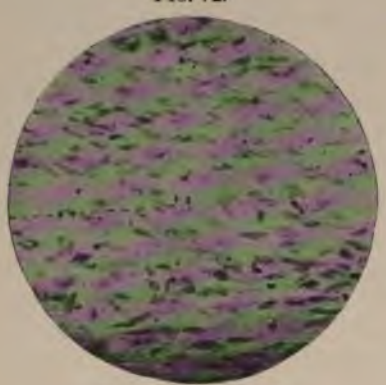
section reveals a highly cellular structure in which the nuclei are elongated and arranged with their long axes parallel. In some parts of the section they appear round because seen in cross-section. Three blood-vessels are imperfectly shown.

Fig. 71 shows a fibro-sarcoma of the soft palate from a woman twenty-three years of age. It was first noticed about seven months before its

removal. The section shows nuclei much like those in Fig. 67, but separated by considerable intervals which are occupied by a rather dense fibrous intercellular substance. One blood-vessel is included in the figure. The chances of metastasis from such a growth is slight.

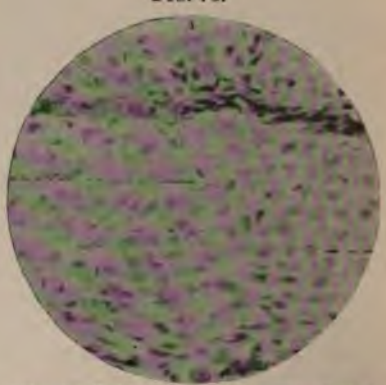
Fig. 72 (fibro-sarcoma) is a portion of the same section depicted in Fig. 71, more highly magnified. Near the centre of the field is a cell

FIG. 72.



Fibro-sarcoma (× 250).

FIG. 73.

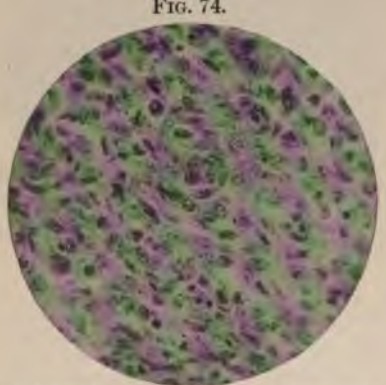


Mixed-celled sarcoma of the neck (× 250).

the nucleus (*a*) of which has just divided. This is a proof of the fact that the cells of this tumor are still proliferating. The cells are shown to be spindle-shaped, and if there were but little intercullar substance, the cells being closely aggregated, the tumor would be a typical spindle-celled sarcoma.

E. *Mixed-celled Sarcoma.*—These sarcomata are distinguished by the polymorphous character of the cells composing them.

FIG. 74.



Mixed-celled sarcoma from a metastatic growth in the inguinal region (× 250).

FIG. 75.

Giant-celled sarcoma of the alveolar process of the jaw (× 50).

In Fig. 73 is shown a mixed-celled sarcoma of the neck from a man aged thirty-nine. About fourteen months before the operation a mole at the site

of the tumor began to enlarge. It was painted with iodine, but continued to grow until it became a nodule about two inches in diameter. It was then removed. The section contains a rather large blood-vessel with thin walls in very close relation to the cells of the tumor. In four places the section contains ragged nuclei which are in the act of dividing (*a*). Some of the cells are round, others spindle-shaped.

In Fig. 74 is shown a mixed-celled sarcoma from a metastatic growth in the inguinal region in a woman of fifty. The cells are large and polymorphic, and their protoplasm is the seat of degenerative changes which give it a coarsely granular appearance.

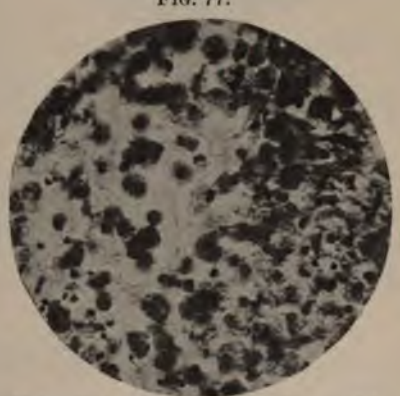
F. *Giant-celled sarcoma* is a variety of sarcoma in which some of the cells are of unusual size and contain numerous vesicular nuclei. They usually spring from bone.

Figs. 75 and 76 illustrate a giant-celled sarcoma of the alveolar process of the jaw from a man forty-one years of age. The tumor had existed two

FIG. 76.

Giant-celled sarcoma of the jaw.

FIG. 77.



Melanotic large round-celled sarcoma of the neck (× 250).

years and a half. This section includes part of the epithelial covering of the gum, beneath which is the normal subepithelial fibrous tissue, condensed by the pressure resulting from the growth of the underlying neoplasm. The tissue of the tumor merges into this "capsule," and consists of cells of various shapes separated by only a small amount of intercellular substance. The large multinucleated giant cells are scattered through this tissue.

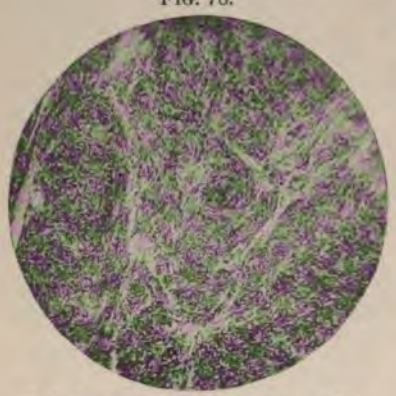
G. *Melanotic sarcomata* have the peculiarity that their cells contain fine granules of brown pigment. The cells may be round, spindle-shaped, or polymorphic.

Fig. 77 is from a section of melanotic large round-celled sarcoma of the neck proceeding from a pigmented mole. The presence of the pigment in the cells of this growth rendered it very difficult to obtain a distinct photograph.

H. *Angeio-sarcoma.*—Sarcomata appear in some instances to arise through a proliferation of the cells of the walls of the blood-vessels (angeio-sarcoma or hæmatangeio-sarcoma). In other instances the endothelial cells of the lymphatic vessels appear to proliferate, with the pro-

duction of a species of sarcoma which has received the name *endothelioma*. In some of these tissues the lumina of the vessels may be preserved. In others they become obliterated, and the probable origin of the growth can then only be inferred. Occasionally still further complications are introduced by the occurrence of degenerations or of infiltrations, which make it extremely difficult to determine the exact nature of the cells taking part in the production of the growth. The so-called "cylindromata" are examples of these occurrences.

FIG. 78.



Endothelioma of the dura mater (× 50).

Fig. 78 shows an endothelioma of the dura mater. The growth is composed of cells probably springing from the endothelium of the dura mater, closely aggregated and showing a tendency to arrange themselves in nest-like groups somewhat resembling the "pearl bodies" of epithelioma.

Psammona is the term which has been given to tumors of sarcomatous, fibrous, or myxomatous nature, in which foci of calcification are present, giving rise to calcareous granules resembling sand. They should not properly be regarded as a distinct species of tumor, their essential nature depending upon the character of the tissues composing them, irrespective of the calcareous deposits.

II. Tumors containing Muscular Tissue.

The muscular tissue entering into the formation of a tumor may be either of the smooth variety (leio-myoma) or of the striated variety (rhabdo-myoma).

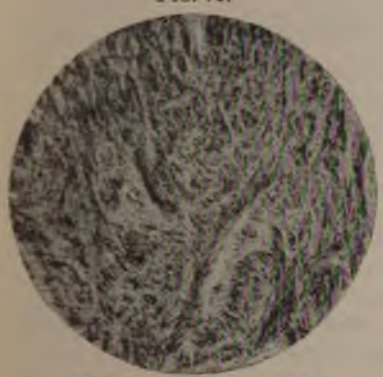
A. *Leio-myoma* springs from the smooth muscular tissue of the part of the body in which the tumor develops—*e. g.* the uterus, the media of the blood-vessels, the muscular coat of the intestines. It is associated with some fibrous tissue, most abundant around the blood-vessels, which vascularize the tumor. Very frequently the fibrous tissue is so abundant as to form a considerable constituent of the neoplasm (fibro-myoma). The muscle-fibres are arranged in bundles variously interlacing with each other. The nuclei of the muscular fibres are rod-shaped, and this characteristic, together with their regular distribution and general parallel arrangement, distinguishes this tissue from fibrous tissue, which in other respects it so strongly resembles.

Fig. 79 shows a section of a myoma of the uterus. The long nuclei of the smooth muscle-fibres lie for the most part with their axes in the plane of the section, but in places they are seen in cross-section, where their axes are perpendicular to the plane of section, and they then appear as small dots. In one place there is a blood-vessel in cross-section, around which there is considerable fibrous tissue.

B. *Rhabdo-myomata* are rare. The striated muscle-fibres are usually

not well developed, the striations being obscure. They are most frequently found associated with other neoplastic tissues in composite congenital tumors, notably in those of the kidney, where the presence of

FIG. 79.



Myoma of the uterus (× 50).

FIG. 80.

Rhabdomyo-sarcoma of the kidney (× 250).

undifferentiated cells of embryonic nature give the tumor a sarcomatous character (rhabdomyo-sarcoma).

Fig. 80 shows a rabdomyo-sarcoma of the kidney from a child. It was a congenital tumor, weighing about two pounds. The structure of the tumor differed somewhat in different portions. The section represented in the photograph is from a portion in which the striated muscle-fibres preponderated. They are shown lying in a tissue of rather cellular fibrous character.

III. TUMORS CONTAINING NERVOUS TISSUE-ELEMENTS.

Neuroma, in the strict sense of the term, is a very rare tumor. Probably the only examples are found in cirsoid neuromata, which are occasionally found in the head, body, or extremities associated with other lesions. Even in these cases the growths are not composed entirely of nervous elements. Their bulk is made up chiefly of fibrous tissue. In the "neuromata" which develop in the stumps left after amputation the increase of nerve-fibres is the result of an effort at regeneration on the part of the severed nerves. The painful neuromata which occur in the course of a nerve or at its termination are really fibromata of the nerves.

FIG. 81.

Neuroma (× 50).

Fig. 81 represents a section through a neuroma following amputation, and shows a number of interlacing bundles composed of nerve-fibres,

with a large admixture of fibrous tissue. The photograph is expected to give an idea only of the general arrangement of the structures. Special modes of preparation are required to reveal the presence of nerve-fibres with any certainty.

IV. Tumors arising from Epithelial Tissues.

Those epithelial hyperplasias which are the result of an increased demand upon the functional activities of the epithelium are not to be classed with tumors. For example, callus of the epidermis is not a tumor. The epidermal horns that are of occasional occurrence might perhaps be considered as tumors consisting essentially of epithelium, but are usually classed as hypertrophies.

In the vast majority of epithelial tumors the growth is not exclusively epithelial. A new-formation of fibrous tissue accompanies that of the epithelium, so that the tumor may be regarded as the neoplastic formation of an imperfect organ rather than of a simple tissue. This is certainly true of the adenomata and carcinomata, though it is less evident in the cutaneous epitheliomata.

Epithelial neoplasmata become malignant when the proliferating epithelium is no longer adequately confined by the fibrous tissue which surrounds it, but makes its way into the interstices of the environing structures. Metastases are then likely to result from this infiltration, either by way of the lymphatic channels or, rarely, through the blood-vessels. The epithelial cells that are thus carried to more or less remote parts of the body retain much of their original character: they and their descendants tend to acquire the form that they would have assumed had they remained at the original site, and they tend to undergo those degenerative changes that are common in the organ from which they sprang.

The connective tissue which proliferates to form the stroma of an epithelial tumor is usually fibrous, resembling the interstitial tissues of the glandular organs. But it may in some portions of the growth assume some other form of connective tissue, as, for example, mucous tissue or sarcoma.

A. *Adenoma.*—This epithelial neoplasm is a somewhat imperfect new-formation of glandular structures. It may have a tubular or an alveolar structure, each tubule or alveolus being lined by a layer of epithelial cells surrounding a distinct lumen and resting upon the stroma, which is the equivalent of the interstitial tissue in a normal gland. The stroma consists usually of a more or less well-developed fibrous tissue.

Not infrequently the alveoli become dilated (cystic adenoma), and in such cases the stroma occasionally develops villous or papillary masses which project into the cystic alveoli. (See Inoma, p. 124).

Tumors are common in which the characters of an adenoma are associated or blended with those of carcinoma. These are designated as adeno-carcinomata.

The section of adeno-carcinoma of pancreas shown in Fig. 82 represents an imperfect glandular structure. In some of the acini there is a distinct though irregular lumen bounded by columnar epithelial cells. The growth shows its atypical character in the general arrangement of the acini and their lack of uniformity.

B. *Carcinoma.*—Carcinomata depart in structure from the type of a normal gland in still greater degree than do the adenomata or adeno-carcinomata. They consist of alveoli surrounded by a connective-tissue stroma, but these alveoli present no lumen. They are filled with epithelial cells. The stroma in some cases appears to be merely the connective tissue normally present at the site of the growth, the interstices of which have become dilated to form the alveoli of the tumor. In other cases the stroma is also of new-formation. The alveoli communicate with each other. The tumor may therefore be likened to a sponge of connective tissue, the spaces of which are filled with epithelial cells. The essential element of the growing tumor is proliferating epithelium no longer definitely held in fixed position by confining connective tissue. In some instances this epithelium subsequently suffers atrophy, and then the connective tissue of the stroma, which seems to have developed as the result of a slow productive inflammatory process, contracts, so that in the place of a tumor there is a diminution in the size of the affected parts ("atrophic carcinoma"). This does not signify that the growth has become innocuous. The atrophy is confined to a part of the tumor, while other parts continue their development.

FIG. 82.

Adeno-carcinoma of pancreas (× 50).

Carcinomata vary in appearance, consistency, and rapidity of growth according to the relative abundance of their epithelial and connective-tissue constituents, according to the character of the epithelium, and according to the degenerative processes which their tissues may have suffered.

1. *Epithelioma* or *cancroid* is the term applied to those carcinomata which spring from stratified epithelium—*e. g.* from the epidermis, the tongue, the cervix uteri. The epithelium invades the underlying tissues, starting in the form of tongues or columns of epithelium which, after reaching the deeper underlying tissues, penetrate and ramify in their interstices, so that in sections they appear as masses of epithelial cells occupying alveoli bounded by fibrous tissue. In these masses of misplaced epithelium it is usual to find peculiar bodies, somewhat resembling pearls to the unaided eye, and composed of imbricated scales of flattened keratoid epithelial cells.

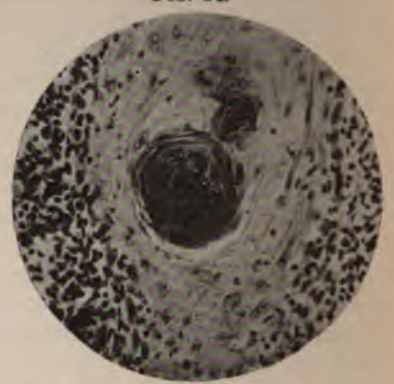
Fig. 83 is from a section of epithelioma of the lip from a man thirty-five years of age. Eleven months before its removal the patient noticed a crack in his lip, which never healed. At first it was painless, but later became hard, nodular, and painful. The section includes portions of four epithelial columns proceeding from the epidermis and invading the corium, two of which contain epithelial "pearls." The connective tissue surrounding these columns has been softened by an acute inflammation, the result of ulceration and subsequent infection. This inflammation is

revealed by an extensive round-celled infiltration, and the softening by the fact that portions of tissue have fallen out of the section.

FIG. 83.

Epithelioma of the lip (× 50).

FIG. 84.

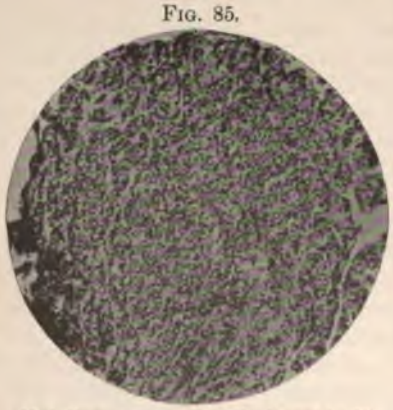


Same section as Fig. 83 (× 250).

Fig. 84 is a more highly magnified portion of the same section. One large and two smaller pearl bodies are represented lying among flattened epithelial cells. These pearl bodies are the result of the retention, on the part of the epithelium even in this abnormal position, of its function of producing horny epithelium. The fibrous tissue around the epithelium has been greatly softened by the inflammation and is the seat of an abundant round-celled infiltration.

2. The term *carcinoma* in a more restricted sense is applied to the carcinomata which have their origin in the proliferation of the epithelium of glands. Although they all agree, essentially, in structure, they differ in certain details which give them different physical qualities, in accordance with which they are usually divided into the following groups:

FIG. 85.



Medullary carcinoma of the breast (× 50).

FIG. 86.

Carcinoma simplex of the breast (× 50).

a. Medullary Carcinoma.—In this variety the stroma is present in very small amount, the chief constituent of the tumor being epithelium.

It is therefore of soft consistence, a quality which is frequently augmented by degenerative changes in the cells of the epithelium.

In the section of medullary carcinoma shown in Fig. 85 the stroma is so small in amount as to appear almost insignificant. It forms a delicate network of vascular fibrous tissue the meshes of which are filled with epithelium. The tumor was from the breast, and its growth was very rapid, with metastases in the lymph-glands, the liver, and the lungs.

b. Carcinoma Simplex.—In this variety the stroma and epithelium enter in about equal proportions into the formation of the growth. Fig. 86 represents a section from a simple carcinoma of the breast. The stroma, consisting of rather dense fibrous tissue, is much more prominent in this section than in the last. The character of the epithelium is the same.

c. Scirrhous Carcinoma.—This form of carcinoma owes its hardness to the abundant, dense fibrous tissue which makes up its chief bulk. The alveoli are small, sparsely distributed through the stroma, and, in the hardest varieties, contain only a few cells. "Atrophic carcinomata" belong to this division.

In Fig. 87 is shown a scirrhous carcinoma of the breast from a woman about fifty years of age. The section is chiefly composed of a very dense fibrous tissue, but the few small alveoli containing epithelial cells reveal its true carcinomatous character. The alveoli have no distinct encircling membrana propria, as would be the case were the growth a diffuse inoma of the breast.

FIG. 87.

Scirrhous carcinoma of the breast (× 50).

FIG. 88.

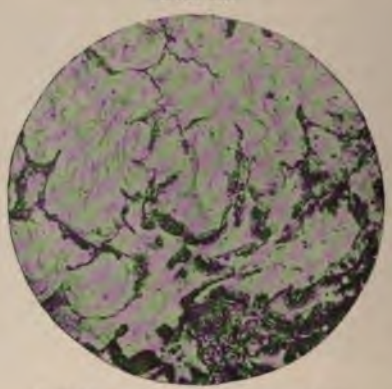
Carcinoma of the breast (× 50).

The foregoing three varieties of carcinoma are not separated by sharply definable distinctions. Intermediate forms of carcinoma are frequently met with, and it is not very unusual to find different portions of the same cancer differing greatly in the relative abundance of epithelium and fibrous tissue. But the grouping given above has more than a superficial value, since those carcinomata which are richest in epithelium are those of most rapid growth and most prone to suffer degenerative changes.

Fig. 88 is from a section of carcinoma intermediate in density between carcinoma simplex and scirrhous carcinoma.

d. Colloid Carcinoma.—This owes its gelatinous appearance to a mucoid degeneration of the epithelium contained in the alveoli of the car-

FIG. 89.



Colloid carcinoma of the lung (× 50).

cinoma. It takes its origin from epithelium which in its normal situations undergoes this change, and this functional peculiarity is transmitted to those cells which enter into the formation of the neoplasm.

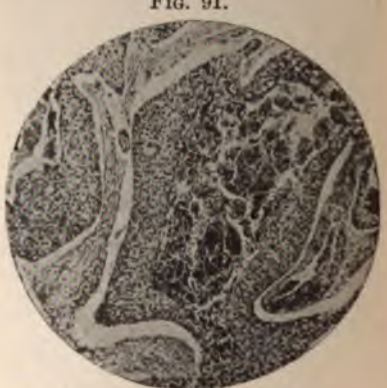
In Fig. 89 is shown a metastatic colloid carcinoma of the lung. The alveolar walls of the pulmonary tissue here constitute the stroma of the neoplasm, upon which the columnar cells of the carcinoma have arranged themselves. The alveoli are filled with the transparent gelatinous substance produced by the epithelial cells.

Fig. 90, from the same section, makes this relationship between the alveolar wall and the epithelium more evident.

FIG. 90.

Same section as Fig. 89 (× 250).

FIG. 91.



Carcinoma of the bladder (× 50).

The colloid carcinoma furnishes only one example of the various degenerative changes which the epithelium of these growths may suffer; other examples are illustrated in the following figures.

In Fig. 91 is represented a carcinoma of the bladder, with fatty degen-

eration and disintegration of the epithelium lying in the centre of the alveoli. This figure also illustrates the intercommunication of neighboring alveoli.

In Figs. 92 and 93 are shown sections of a carcinoma with hyaline degeneration of the epithelium (carcinoma cylindromatosum) from the

FIG. 92.

FIG. 93.

Carcinoma with hyaline degeneration of the epithelium (× 50 and 250, respectively).

scalp of a man aged seventy. It had grown for two years, and was about three-quarters of an inch in diameter.

Fig. 94 is an illustration of the manner in which carcinoma infiltrates the neighboring tissues. It represents the adipose tissue surrounding a breast which was the site of a cancer. Epithelial cells from the latter have made their way between the fat-cells. Below and to the left is a group of epithelial cells which has apparently excited an inflammatory reaction which will result in the development of a fibrous stroma. A little to the left of the centre are three epithelial cells (*a*) with dark irregular nuclei in the act of dividing.

FIG. 94.

Carcinoma invading fat (× 250).

In the foregoing sketch no attempt has been made to describe all the neoplasmata: only a brief outline of the more common forms has been undertaken. For a thorough treatment of the subject the reader must refer to special works on pathological anatomy and to the technical journals.

HERNIA.

By WILLIAM T. BULL, M. D., and WILLIAM B. COLEY, M. D.

Hernia in General.

The term "hernia" is used to denote the protrusion of any viscus from the cavity in which, under normal conditions, it is contained. In this sense it is applicable to hernia testis, hernia cerebri, hernia of the lung (pneumatocele), where the corresponding viscera, as a result of traumatism or pathological processes, project from their cavities. When used alone it is applied to a protrusion of one or more of the abdominal viscera, and is synonymous with the ordinary term "rupture." "Prolapse" or "protrusion" should be used when referring to the escape of viscera complicating wounds of the abdomen.

Hernia occurs through openings in the abdominal wall, which openings, normally patent in fœtal life, have failed to close at birth, owing to some arrest of development—*e. g.* the umbilicus and the process of peritoneum forming the tunica vaginalis of the testis. In such cases the hernia is said to be congenital. The protrusion may also occur at points where the abdominal wall is naturally weaker than elsewhere—viz. in the femoral region, where large vessels emerge from the pelvis; at the inguinal canal, where the spermatic cord passes; at the umbilicus, where muscular planes are lacking; and at points where an interval exists between muscular fibres protected only by connective tissue, as in the diaphragm and in the triangle of Petit, between the external oblique and latissimus dorsi muscles. In these instances the rupture is said to be *acquired*. Furthermore, the abdominal wall may be weakened at any point by operations or accidental wounds, and to a hernia occurring under such conditions the term *traumatic* is sometimes applied. The site of the opening gives the name to the hernia, and we have, as common forms, inguinal, femoral, umbilical, ventral; as rare varieties, diaphragmatic, lumbar, obturator, sciatic, pudendal, perineal, and rectal. The last three are conveniently included under the name of "pelvic hernia." "Ventral hernia" is applied to protrusions at other than the above anatomical sites. All of these forms are spoken of as *external* hernia, in distinction from *internal*, in which the protrusion of the viscus occurs through openings or anomalous pouches in the folds of the peritoneum. These are referred to elsewhere, as they fall, from a clinical standpoint, among the forms of intestinal obstruction.

Mode of Formation and Dangers.—Through one of these congenital orifices or weak spots in the abdominal wall a viscus protrudes, pushing before it the parietal peritoneum, until it passes beyond the plane of the abdominal wall. This protrusion is covered by different layers according to the site of the hernia, but in all cases the innermost layer consists of

a pouch of thin parietal peritoneum called the *sac*. Left to itself, the protrusion tends to become larger by the addition of other viscera forced out by the constant intra-abdominal pressure. It constitutes always a source of weakness and inconvenience, due to functional disturbances of the viscera. So long as the viscera can be readily returned within the abdomen and retained there, or return spontaneously on lying down, the hernia is said to be *reducible*. Hernia, however, is liable to accidents and to pathological changes resulting from the displacement of the viscera. These accidents constitute real dangers to life from interference with the passage of feces, or with the circulation of the parts, and may give rise to irreducibility, obstruction, inflammation, and strangulation.

Anatomy.—A hernia consists of the sac, the coverings, and the contents. The hernial orifice, or point of exit from the abdomen, corresponds to one of the sites already referred to where the abdominal wall is weaker than elsewhere. The sac is always a prolongation of the parietal peritoneum. In the early stages of a hernia the sac is merely a pouting or bulging into the hernial orifice, with a narrow end and a wide mouth or base, but by a gradual process of elongation and distention from pressure of the contents it becomes a well-rounded or pyriform pouch. The narrowest part of this pouch, corresponding to the hernial orifice, is called the "neck" of the sac, while the part external and beyond is called the "fundus." The sac, as thus formed, is said to be acquired, while in protrusions into the open tunica vaginalis or through the patent navel it is properly termed preformed. The latter is also described as a congenital sac, though the term "congenital hernia" is made to embrace forms in which the sac is acquired during life. It owes its existence to conditions which exist at birth, but the hernia itself forms later in life (congenital forms of inguinal hernia). The neck of the sac is naturally constricted by the pressure of the parts through which it has passed. In course of time it is thrown into folds and presents a wrinkled appearance. Adhesions between the folds and thickening of the peritoneal membrane may in old cases make this neck rigid and unyielding—a characteristic uniformly given it by the older anatomists. Many recent dissections in the performance of operations for hernia have demonstrated that when the tissues outside the neck are divided the folds disappear and the membrane becomes smooth. Adhesions may form between the inner surface of the sac and the viscera, especially when the latter are only partly reduced and pressed upon by a truss. The neck, at first more or less elongated according to the orifice it traverses, gradually becomes shorter, and may be said to be in general but a few lines in length. The fundus, or remainder of the sac, may be reducible at first from the loose texture of the extraperitoneal fatty layer, but it soon becomes adherent to its coverings as a result of a mild grade of connective-tissue inflammation. The shape of the body of the sac is influenced by the nature of its contents and the arrangement of tissues in which it lies, and is best described in connection with special herniæ. In general it is of an elongated oval or pyriform shape. This is modified by the pressure of bands outside, throwing it into "hour-glass" or other irregular shapes, by the existence of pouches of the peritoneum, and by adhesions occurring between its walls. The membrane preserves its natural elasticity and semi-transparency for a long time, and it is excep-

tional to meet with sacs where the peritoneum can truly be said to be greatly thickened and opaque. It varies in thickness in different parts, especially in umbilical hernia. If the contents of the hernia be kept within the abdomen and pressure applied continuously over the sac, adhesion and obliteration of the sac result, and this, with closure of the orifice, is the process by which a cure is effected by the wearing of a truss. This process may occur spontaneously in cases of brief duration both in infants and adults. The neck alone may be obliterated and the body remain unclosed, and be the seat of a collection of fluid (hydrocele of a hernial sac). This has been observed chiefly in femoral hernia. Calcareous plates have been found in the sacs of old herniæ, and tubercular deposits also.[1] Malignant disease may be communicated to it by similar deposits in the contents. Certain herniæ are said to have "no sac," as, for instance, the bladder, sigmoid flexure, and cæcum. This is not strictly true: a sac exists, but on account of the partial investment by the peritoneum they are either partly or wholly outside of it. (It is well to remember that a hernia existing from birth, and being irreducible, is likely to contain the cæcum on the right side and the sigmoid flexure on the left.) Both these offer unfavorable conditions for effecting a radical cure. The *coverings* of the sac are the tissues outside it, which vary in thickness and character according to the site. The different "layers" much emphasized by the anatomist are of less importance to the surgeon, but from changes due to their thickening and fusion they are not always demonstrable. In hernia which has not been treated they are apt to be thicker than normal, chiefly from hypertrophy of the extra-peritoneal fatty layer. This is especially marked in femoral hernia. A French writer has called this *lipoma herniaire*. The steady pressure of a truss causes an atrophy of the skin and a thinning of the deeper layers, except opposite the neck, where the naturally firm and fibrous structure becomes thicker and more unyielding than normal. Cysts and bursæ are occasionally found. The *contents* of a hernial sac are a part of the abdominal viscera only; most frequently the omentum and small intestines (ileum and jejunum) are found; after this parts of the large intestine. All the viscera, except the pancreas, have been found in some form of hernia. Often both intestine and omentum are found. They may be natural in appearance, but they are liable, if long protruded, to undergo changes. The omentum may become adherent or hypertrophied and denser, with or without adhesions. Cysts may form in it. The intestine becomes more vascular, and the walls and mesentery thicker, and adhesions form. The appendices epiploicæ, with or without the large intestine, are met with, and loose bodies occasionally encountered are supposed to be due to their becoming detached. A small amount of peritoneal fluid may be present, and this is greatly increased by any injury to the hernia, an ill-fitting truss, or efforts to reduce it.

The following terms are employed to distinguish hernia according to the contents of the sac: *epiplocele*, one containing omentum; *enterocele*, one containing intestine; *entero-epiplocele*, when both are present; *cystocele* is used for hernia containing the bladder.

When only a portion of the circumference of the intestine is contained in a hernial sac the name of *partial enterocele* is appropriate,

[1] *Brit. Med. Journ.*, Apr. 18, 1891.

though this condition has been formerly described as Littre's hernia. It is of significance only in strangulated hernia, when the lumen of the gut is not wholly obstructed, as shown by movements of the bowel, while the patient has vomiting and local signs of strangulation. The same symptoms are produced when Meckel's diverticulum is strangulated. This must be a great rarity, since this anomaly is met with in the intestine in about two of one thousand autopsies (Macready). Partial enterocele has been found most frequently in femoral and obturator hernia.

Multiple hernia is the term applied to the coexistence of two or more forms of hernia in the same subject. Fig. 95 illustrates a case observed by Finney:[1] a child twenty-one months old presented a double inguinal and an umbilical hernia. A man forty years old applied for treatment at the Hospital for Ruptured and Crippled who had double inguinal, double femoral, and an umbilical hernia. These were of the acquired variety.

FIG. 95.

Predisposing Causes. — *Heredity.* — That heredity has some influence in the causation of hernia has long been recognized, but until recently no satisfactory data have been collected to determine the nature and extent of this influence. The records of the London Truss Society have been carefully examined by Macready with the following results: About 25 per cent. of persons with rupture give a family history of hernia. In 2639 families in which father or mother or both parents were ruptured there were 3586 persons ruptured, or an average of 1.35 persons per family. Supposing 6 persons to be in each family, this gives a percentage of 22½. In families not subject to hereditary influence there is 1 person ruptured per family, or 16.6 per cent. The hereditary influence of the mother on female children is double that of the father, and when both father and mother are affected the proportion of children ruptured is increased.

Age has more or less influence in producing hernia. Of 1000 males ruptured, 175 are affected in the first year. Of 1000 females ruptured, 91.6 are affected during the first year of life. About 40 per cent. are ruptured before the age of thirty-five, and 60 per cent. after that age. The largest number are ruptured during the period when most subject to *exciting* causes—*e. g.* strain.

Elongation of the mesentery has been frequently given as a predisposing cause, but the investigations of Malgaigne, Callender, and more recently of Lockwood, show that a normal mesentery will permit the intestine to pass beyond the inguinal and femoral rings. A mesentery which is abnormally long may increase the tendency to a hernia, provided other and more important causes be present.

Occupation has a decided influence in causing hernia, and an analysis of the different trades represented in persons ruptured is of considerable

[1] *Johns Hopkins Hospital Reports*, 1893.

interest. In a general way, it may be said that those trades requiring the most severe muscular effort have the highest proportion of persons ruptured. In Macready's tables gas-workmen are at the head of the list, with coal-heavers, gardeners, dock-laborers, and blacksmiths closely following, while clerks and tobacconists show the smallest percentage.

The noticeable decrease in the number of ruptures occurring after fifty years of age can be explained by the fact that, as a rule, work after that period is less severe.

Parturition has a decided influence in causing hernia, especially umbilical, and after the childbearing period has passed there is an even greater decrease than in the male.

Weakening of Abdominal Walls.—Anything that tends to weaken the abdominal walls, indirectly predisposes to the formation of hernia—*e. g.* (1) traumatism followed by cicatricial tissue, which gradually becomes thin and yielding;

(2) Contusions, causing partial or complete rupture of abdominal muscles;

(3) Obesity, with consequent atrophy of muscles;

(4) Gradual atrophy of muscles and tissues about the hernial orifices, common with advancing age, and causing enlargement of hitherto normal rings;

(5) Abdominal tumors, cardiac or renal disease, which by producing ascites weakens the abdominal walls as well as increases the intra-abdominal pressure.

Exciting Causes.—These can be classed as immediate or direct, and mediate or indirect.

(1) *Immediate.*—The chief example of this is muscular effort or sudden strain. A very large proportion of cases of hernia acquired in adult life are first noticed during or soon after a severe muscular effort —*e. g.* lifting, straining at stool, or coughing. The hernia may not be very pronounced at first. Usually only a slight fulness is noticed at the site of rupture associated with some soreness and discomfort. Unless a support is applied the symptoms continue, and in a short time a well-marked tumor will probably be found. In a few well-authenticated cases a pronounced hernia has immediately followed the sudden strain when absolutely no signs of a hernia had existed previously. In a few of these cases strangulation has occurred synchronously with the first appearance. Such cases are very rare, but should be borne in mind. There was recently observed at the New York Hospital a case of this kind. The patient, a young man twenty years of age, had never noticed his testicle on the right side. One day, while simply walking, without any unusual strain, a swelling the size of a large hen's egg appeared in the right groin. Severe pain followed immediately, and in a short time nausea and vomiting. The operation disclosed a strangulated loop of ileum in conjunction with a partially descended testis. A similar case was operated upon at the same hospital seven years ago, the only difference being that in the latter case the testis was normal.

(2) *Mediate or Indirect Causes.*—Among these may be mentioned chronic bronchitis, pulmonary affections in general, and habitual constipation.

REDUCIBLE HERNIA.

Reducible hernia presents itself in the form of a soft tumor or swelling appearing at one of the hernial orifices when the patient is in the erect position or upon coughing or contracting the abdominal muscles. It disappears on lying down and on making pressure over it. If grasped between the fingers while the patient coughs, a distinct impulse can be felt. This swelling may be formed suddenly with local pain after some severe muscular effort or such traumatisms as a blow, fall, or kick. Under these circumstances it is usually of a size readily seen or felt. More frequently it is developed gradually, with, or preceded by, sensations of discomfort or weakness about its point of exit. These sensations are most pronounced after standing or walking several hours. The swelling at the outset, when formed gradually, is no more than a mere fulness, but it becomes eventually well defined and rounded or pear-shaped in form, and narrowest at its neck. Other physical signs are modified by the contents. An *enterocele* feels smooth in its outline, and is elastic and resisting; the impulse on coughing is well marked, and extends both toward the sides and extremity of the sac. A "gurgle" (gurgling sound), due to the presence of gas in the gut, is heard on pressure, and the contents disappear from under the fingers with a suddenness that is characteristic. On percussion tympanitic resonance is heard if the volume of gut be large. An *epiplocele* feels inelastic and doughy, uneven and lobular in outline; the impulse on coughing is most marked at its extremity, and it returns slowly and without "gurgle" to the abdomen. Percussion gives a dull note. In an *entero-epiplocele* the presence of both omentum and gut can be made out only in large herniæ, where different parts of the tumor may give different physical signs. In smaller ones the reduction of a portion of the contents, with the characteristic signs of gut, may demonstrate that the remainder is omentum. It should be remembered that empty, inflamed, and congested intestine will sometimes feel doughy and give a dull note, and that the presence of fluid in the sac may obscure the characteristics of both omentum and intestine.

The sensations of weakness and dragging pain noticed at the outset are aggravated as the protrusion increases in size, and if the hernia be left unsupported they are a sufficient source of annoyance and weakness to incapacitate one for hard work, while functional disturbances of the bowels (in enterocele) are not infrequent. When supported or held within the abdomen by a truss these symptoms are not noticed.

Men with hernia are not eligible to the army or navy, fire or police service, and are only accepted as good risks by life-insurance companies when the rupture is of moderate size, well reduced, and held so by a truss.

Treatment.—In view of its tendency to enlarge, all forms of hernia must be treated either by methods that may be called *palliative* (mechanical) or by *operative* procedures (radical cure). In the former the contents of the sac, after reduction, are held within the abdomen by the constant pressure of a truss upon the hernial orifice; in the latter the attempt is made to permanently close that orifice. This is frequently spoken of as the radical cure.

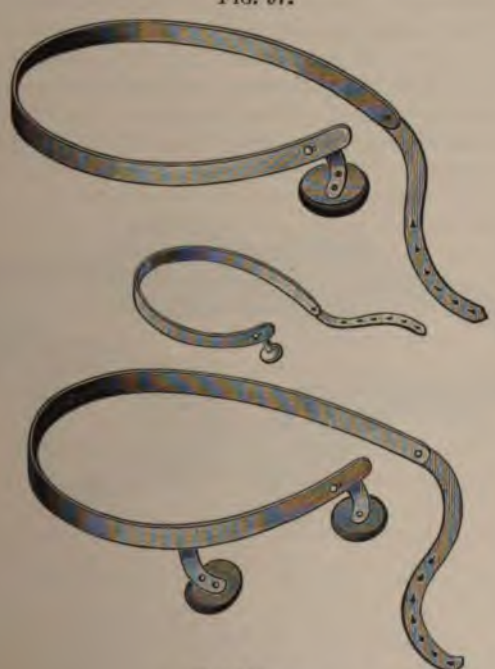
Palliative treatment will, in most cases, relieve the sense of weakness and permit ordinary exertion and even hard work. In some instances it effects a cure, especially in children and the small hernia of young adults

FIG. 96.

Hood truss.

of very recent formation. It is carried out by means of bandages, trusses, and belts. The truss is made up of a *pad*, to cover the hernial orifice, which is attached to a metallic *spring*. Steel is the best material for this purpose. The spring encircles all or a part of the circumference

FIG. 97.

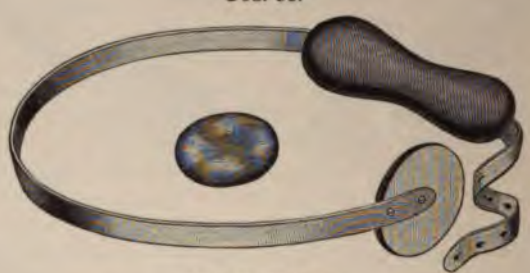


Knight truss.

of the trunk, and is held in place by its own elasticity and the aid of straps. Figs. 96, 97, 98, 99 represent forms of trusses in common use for both inguinal and femoral hernia. Various modifications are adopted

for different forms of rupture, to be mentioned later. In all the pad is of oblong or circular form, and is directly continuous with the spring, or attached to it by a shank, which is sometimes so arranged as to permit the pad to be placed at different angles. The pad is made of hard rubber, celluloid, cork, or of wood covered with several layers of cotton and one thickness of chamois-skin on the outside. A rubber bag containing water or glycerin and enclosed in a silk covering is sometimes

FIG. 98.

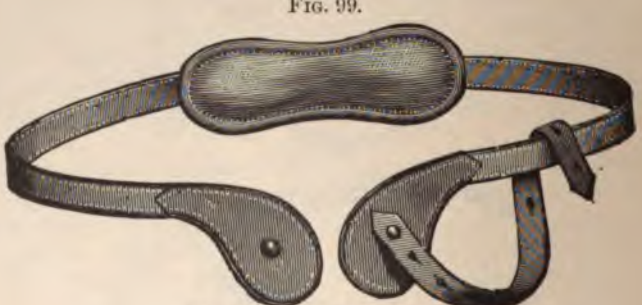


Cross-body truss.

employed. The spring may be protected by leather or coated with hard rubber or celluloid. In the ends of the spring, buttons are inserted which hold straps passing round the body.

Bandages with pads of gauze and lint, or a skein of worsted, may serve a useful but temporary purpose. Elastic belts, with or without pads, are suitable for protrusions at irregular sites and for the support of the relaxed abdominal walls which so often accompany hernia.

FIG. 99.



Plain double truss—soft pads.

The object to be accomplished by the truss should be the complete retention of the hernia with comfort to the patient. In other words, it should *control* the hernia, and do this without the wearer's being conscious of its presence. Various degrees of strength of spring must be used to counteract the tendency of the rupture to escape in different patients, but the pressure exerted must be never *greater* than is required to keep the protrusion reduced. Too severe pressure is liable to be painful, and causes atrophy and weakening of the tissues beneath.

The application of the truss, and even its selection, may be left to the

instrument-maker, but the practitioner should always make sure of the existence of the rupture and its complete reducibility. He should note the variety, site, contents, and volume, and inspect the truss after it has been fitted. Neglect to do this, a too common fault, has led patients to submit themselves wholly to the instrument-maker, and has invited the establishment of untrustworthy "rupture-cure" institutions. The effects of the treatment should be watched by subsequent examinations. The *time* to apply the truss should be the earliest possible moment after the diagnosis is made. This is as true of infants as of adults.

Precautions.—One must be assured that the reduction is complete. The truss should be applied in the recumbent position, and worn both day and night by infants and young children. Adults should be instructed how to reduce the rupture, and its varying conditions should be explained. They may discard it at night if the rupture does not descend, but it should be always at hand and applied even for brief periods of standing. Straining at stool and all severe lifting efforts must be avoided, but ordinary exercise may be enjoyed. It is wise to provide an extra truss for travelling, and one covered with rubber for bathing, and in exceptional cases one of stronger spring may be used while taking exercise. Once well fitted, the patient ought to be free from all annoyance except the fact that he is dependent for his well-being on a mechanical support. The skin beneath the pad and spring may become abraded. This should be prevented by bathing with alcohol and the subsequent use of toilet-powder or talcum. The raw surfaces are best treated with iodoform or bismuth, the patient being kept recumbent and deprived of the truss till healed. In infants the pad and spring should be covered with rubber, and great care exercised to dry and powder the parts after urination.

It is impossible to say how long the truss must be worn in a given case. One expects improvement to follow in most cases. The rupture when protruded is found to be of less volume and is held with lighter pressure. The orifices feel narrower, and the protrusion may even remain out of sight for several days without support. Most infants can be cured in a year or two if properly cared for. In children up to ten years of age there is still a fair prospect of cure. After puberty it is less, and after twenty or thirty years of age it is generally conceded there is but little chance of a cure. It is assumed that the treatment is begun promptly. As soon as improvement is apparent the spring of the truss may be made lighter, but the truss should not be discarded. In fact, relapses are common, and except in infants and young children it is wiser to continue indefinitely a light support.

In femoral hernia there is little chance of cure by mechanical means, though by pathological processes the orifice and sac are sometimes obliterated.

There are not a few obstacles to the retention of the hernia by a truss. Distention of the abdomen and hernial sac by ascitic fluid often prevents its use, and the rupture can only be supported by a sling and bag. General debility, with relaxation of the abdominal walls and the hernial orifice, may prevent perfect control. In corpulent individuals an abdominal belt may be worn in addition to the truss. Old persons with flabby and atrophied hips often require support from the shoulder to keep the truss from slipping down.

In sacs that are *apparently* empty, the failure of the truss is not infrequently found to be due to small slips of adherent omentum, the presence of hydrocele of the sac, or a portion of the cæcum or sigmoid flexure. These obstacles can best be met by operative procedures.

Operative Treatment of Hernia, or its Radical Cure.

Historical Note.—The history of operative procedures may be divided into three distinct periods—ancient, mediæval, and modern.

I. Ancient methods, beginning with Celsus in the first century and extending to the tenth.

II. Mediæval, beginning with the tenth century and extending to the close of the Middle Ages, when all operations were given up.

III. Modern, from the discovery of subcutaneous surgery to the present time. This period should properly be subdivided into two parts: 1. Including the subcutaneous method; 2. The open method, following soon upon the introduction of antiseptic surgery.

Ancient.—These numerous operations cannot be described in detail, but the principles underlying the most important of them will be noted.

To Celsus we owe the origin of operations upon non-strangulated hernia. He was very conservative in his selection of cases for operation, and many of his rules could scarcely be improved upon to-day. Strange as it may seem, he did not advise operation for strangulated hernia. He operated only upon children between the ages of six and fourteen years, in good health, and with no very large herniæ. He advised against operating for umbilical hernia in children. His method of operating upon inguinal hernia was to expose the sac by free incision, and it is probable that he removed it. The testicle was left uninjured.

Before the time of Celsus several methods were employed to cure umbilical hernia. These consisted in ligature of the pedicle after reduction of the hernia, with or without opening the sac. Celsus introduced the modification of ligating the sac high up after reduction of the hernia, then treating the portion beyond the ligature with the actual cautery.

Oribasius, in the fourth century, describes several ingenious methods of operation, many of which in recent years have been revived as new and original. He paid little attention to strangulated hernia, and, like Celsus, did not advocate castration.

Paul of Ægina, in the seventh century, operated very much according to the methods of Celsus, with one important exception: he introduced castration, and this remained as a step in hernial operations until all methods for radical cure were discarded.

Mediæval.—The Middle Ages mark the introduction of a great number of variations in the technique of the older methods, the chief of which are the following: castration, exposure and ligature of sac, invagination of the sac and scrotum, and cauterization.

In the tenth century attention began to be, for the first time, fixed upon the mechanical treatment of hernia, and with the gradual perfecting of appliances, operations were more and more rarely resorted to, and seldom advocated by regular practitioners.

Modern Methods.—This period properly begins in 1831, when Stro-

meyer discovered and introduced subcutaneous surgery. Under subcutaneous methods may be classed the injection of various irritating fluids into and around the sac (Velpeau, Pancoast, Heaton, Schwalbe). There is a disposition to revive this method at present, especially by irregular practitioners, but all experience goes to prove it of but temporary value.

Gerdy's and Wutzer's operations may be called the first of the modern operations. The principles involved in both are the same—viz. invagination of the scrotum within the canal and permanent fixation. Gerdy's operation was first done in 1835, and Wutzer's about the same time.

Wood's operation was a combination of the subcutaneous and open methods, and was extensively adopted until superseded by the various operations that were brought out soon after the advent of Lister's method of wound-treatment. With the introduction of antiseptic surgery there came a distinct return to "ancient" methods. Lister and Steele were the leaders of the movement, and were soon followed by German surgeons. Czerny in 1876 published a series of cases and described his method, which in brief was an obliteration of the sac and a closure of the canal and external ring with catgut or silk sutures. The principles upon which modern operations are based are the following:

1. Simple ligature of sac and extirpation (Socin).
2. Ligature of sac and suture of canal (Czerny, Banks, Barker, Champonnière, MacCormac).
3. Infolding sac and suture of canal (Macewen).
4. Torsion of sac and suture of sac in canal (Ball).
5. Torsion of sac and suture of canal with sac external to aponeurosis of external oblique (Kocher).
6. High ligature of sac and suture of canal after displacement of cord (Bassini, Marcy, Halsted).
7. High ligature of sac and closure of canal by cicatricial plug, the wound being allowed to heal by granulation (McBurney).

Mortality.—Excluding the cases operated upon by Wood's method, also the tables of Leisrink and Segond, which were published eleven years ago and include the early and scattered cases, we have collected 5000 cases with 58 deaths, or a mortality of 1.16 per cent. (This mortality does not include strangulated cases.) This shows a distinct advance in technique over the statistics of Leisrink, based on 169 cases in 1882. These show a mortality of $8\frac{1}{8}$ per cent., and, adding the deaths that occurred from coincident disease, which are included in the new table, the mortality is raised to $11\frac{5}{8}$ per cent.

It is interesting to compare the causes of death in the earlier and later tables. In Leisrink's statistics of 14 deaths, 9 were due to sepsis; gangrene of the scrotum and skin occurred in no less than 3 cases; 2 died from hemorrhage, and 1 from shock; 1 died on the fourteenth day from embolism of a pulmonary artery. The reduced mortality of the more recent cases is undoubtedly due to more rigid aseptic technique, as well as to a more careful selection of cases.

Accidents and Complications.—The following may occur during or after the operation: hemorrhage due to faulty ligature of omentum or to injury to an unrecognized spermatic artery (two fatal cases have occurred from

this cause); ligature of omentum too close to the bowel, resulting in subsequent perforation of the bowel; simple or suppurative inflammation of omental stump after ligature; injury to omentum, bowel, or appendix due to failure to open and examine sac before removal; injury to vas deferens from insufficient care in separating it from the sac; injury to unrecognized bladder in the sac; shock; nephritis; peritonitis.

Indications and Contraindications for Operation in Reducible Hernia.—A careful study of the large number of cases operated upon by the best of the modern methods shows that in a large proportion of well-selected cases the hernia remains cured for at least several years after the operation. Sufficient time has not yet elapsed to fully demonstrate how many of these will be entitled to be called permanent.

There are already enough data to prove that relapse is most likely to return during the first six months after operation. The second six months is the period next in order of frequency. About 65 per cent. of relapses occur in the first six months; about 85 per cent. of relapses occur during the first year after operation. A number of cases are reported sound more than ten years after operation. The inability of many surgeons to trace their cases to final results makes it impossible accurately to estimate the proportion of cures, but enough have been traced to warrant the following conclusions:

1. The mortality from operations in properly selected cases, in the hands of skilled surgeons, is so low that it can almost be disregarded (less than $1\frac{1}{2}$ per cent. in 5000 cases collected by the writers).

2. The majority (60 to 90 per cent.) of the cases operated upon remain sound for a number of years.

3. When relapses do occur, the hernia is more easily controlled than before operation.

The best results follow operations performed in childhood and youth. Extreme age is, as a rule, a contraindication, and operation should not be resorted to in persons under four nor over fifty years of age unless special indications exist. Operation should not be advised in children until a truss has been carefully tried without benefit, or unless the conditions are such that proper mechanical treatment cannot be carried out. From December, 1891, to March, 1895, 250 children under fourteen years of age were operated upon for radical cure at the Hospital for Ruptured and Crippled by Bull and Coley, with 3 deaths and 4 relapses. Broca[1] has operated upon 477 children with but 2 deaths, and in 250 cases traced there were but 3 relapses. Broca's method is high ligature of sac and closure of canal with silk sutures (not buried), without transplanting cord.

Operation should not be advised in the very voluminous herniæ of middle age. The mortality in these cases is much higher, and the prospect of a permanent cure is not sufficient to warrant the risk. Kramer[2] has collected cases of voluminous herniæ varying in size from the double fist to the child's and adult's head.

Adherent and irreducible herniæ are best treated by operation, provided there are no contraindications.

[1] Congress of Pædiatry (Bordeaux, 1895), *Rev. des Maladies de l'Enfance*, 13, 1895, 426.

[2] *Arch. f. klin. Chir.*, Bd. 50, S. 260.

Estimation of the Value of Various Methods.—All methods which involve the principle that cicatricial tissue forms a barrier, preventing a return of the hernia, have been or should be abandoned. The principle is false in theory, and the large number of relapses that have followed these methods prove them to be no longer justifiable in practice. Furthermore, when relapse does occur the cicatricial tissue yields rapidly, and often becomes so thinned that no form of support can be worn with comfort.

Perfect primary union should be regarded of first importance in all operations, and anything that materially interferes with securing it should be discarded. Hence the attempts to close the canal by invagination of the sac, or by plugging it with omentum or muscle or bone, are not to be recommended.

The suture material is also of very great importance. Many of the failures of the earlier operations were undoubtedly due to the use of sutures that were absorbed before union of the parts had had time to take place. The tissues encountered in the inguinal canal are largely tendinous in structure, and such tissues require several weeks for perfect union to occur.

Silkworm-gut and silver wire have been and are extensively employed for the buried sutures. It is believed by many that if properly sterilized they will remain indefinitely, in the larger proportion of cases, without causing trouble. They are all, however, foreign bodies, and in a certain number of cases, by no means small, they tend to seek the surface and form sinuses which are very troublesome and slow in healing. Cases have been observed in which the patients have been incapacitated for work for months, and in one case nearly a year, on account of this condition. In one case observed at the Hospital for Ruptured and Crippled silkworm-gut sutures were removed six months, two and a half years, and three years and eight months after operation. The original wound had healed by perfect primary union. In all 18 patients with sinuses due to wire, silk, or silkworm-gut have been encountered.[1]

Kangaroo tendon, which was first introduced in this country by Marcy, has none of these objections. It remains unabsorbed for two or three months.[2] The kangaroo-tendon sutures have been tried very extensively, and the primary and final results have been superior to those in cases operated upon by the same methods when non-absorbable sutures were used.

Up to the present time Bassini's operation has given the best results. It has been performed the past eight years by its originator, and for more than five years by other surgeons. Bull and Coley have operated upon upward of 300 cases by Bassini's method, with 3 deaths and 7 relapses. (The relapses were in all cases very slight.)

The method of Halsted, in its essential features, closely resembles Bassini's. The chief points of difference, however, ligation of most of the veins of the cord and transplanting the cord itself, so that it lies external rather than internal to the aponeurosis of the external oblique,

[1] "Disadvantages of Non-absorbable Suture in Operations for the Radical Cure of Hernia," William B. Coley, *N. Y. Med. Journ.*, Feb. 29, 1896.

[2] *Ligature of Arteries in Continuity*, Ballance and Edmunds.

do not appear theoretically to constitute any advantage over Bassini's method. Practically, the results of Halsted himself are inferior to those of Bassini.

Irreducible Hernia.

An *irreducible* hernia is one in which the contents of the sac cannot be returned, yet there is no interference with the function or circulation of the bowel. In this abnormal situation the hernial contents are liable to accidents which may give rise to obstruction (incarceration), inflammation, and strangulation. Irreducibility is met with more frequently in umbilical than in inguinal and femoral hernia. It is uncommon in chil-

Fig. 100.

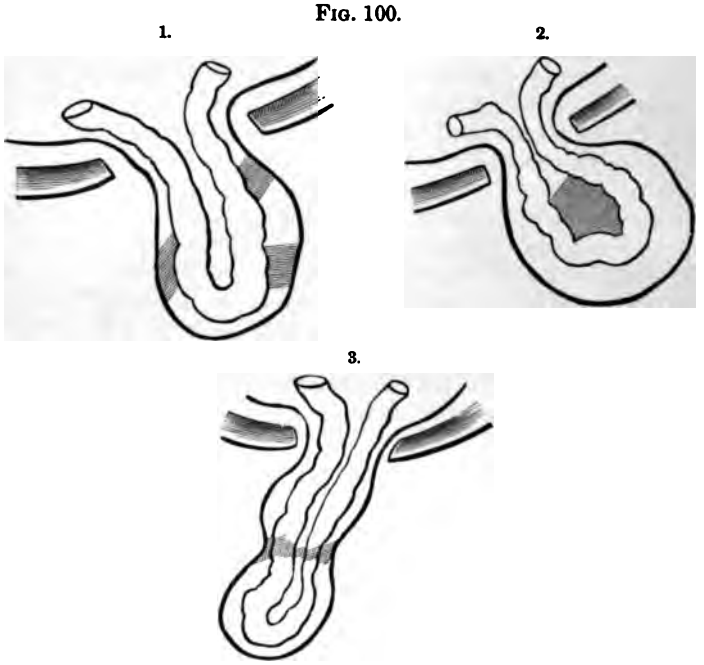


Diagram to illustrate adhesions as a cause of irreducibility: 1, adhesion between contents and sac; 2, between contents themselves; 3, between walls of sac.

dren and young adults, except in the rare forms of congenital herniæ of the cæcum and sigmoid flexure. These are irreducible from their beginning, and the condition is a *permanent* one. Irreducibility is most frequent between the ages of thirty and sixty. It is most frequently caused by adhesions within the sac, either of the sac to the contents, of the contents to each other, or between the walls of the sac, forming bands or irregular constrictions. The omentum becomes irreducible without adhesions from thinning of its neck and thickening of the portion beyond, so that it becomes too large to pass the hernial orifice (Fig. 101). The appendices epiploicæ may be similarly affected. These conditions *may* cause only temporary irreducibility, but this may eventually become permanent. From accumulation of gas or fæces in constipation, causing increase of bulk in the contents, there may be a temporary irreducibility.

That which is most frequently concerned is the omentum (90 per cent. of 286 cases noted by Macready), and next in order the small intestine. In entero-epiplocele the intestine is apt to be free, the omentum adherent. Serous fluid in varying quantity is also found in the sac, especially after bruising or efforts at taxis. In large enteroceles the intestinal loops may be united by numerous adhesions—a circumstance which renders their operative treatment a formidable task.

FIG. 101.

Hypertrophied and adherent omentum in hernial sac from patient operated in New York Hospital.

Clinical Features. — Except for its fixed position in the sac the irreducible hernia has no features apart from the reducible. Impulse on coughing is usually present, except occasionally in small epiploceles. It tends to increase in size, with aggravated sensations of weakness, discomfort, and even pain. Patients are liable to frequent attacks of colic, to irregularity of the bowels, and to the accidents of inflammation and strangulation. This is true even of epiploceles, which, as a rule, give little local annoyance; but the plug of omentum, instead of preventing descent of fresh contents, actually invites it by keeping the orifice open. The condition is certainly one of considerable risk. Patients cannot take exercise without risk of harm to the contents, and the lack of it invites the occurrence of functional disturbances. It is not unusual to meet with cases of brief irreducibility, which become reducible after a few days spent in bed, and even in cases of long standing the hernia has occasionally been reduced spontaneously during the course of a protracted illness.

Treatment.—Patients with irreducible hernia *in general* should give up active exertions, live on simple diet, and carefully regulate the bowels. Neither enterocele nor epiplocele as a rule will bear without pain the pressure of an ordinary truss, but one provided with a "concave" pad does good service. The edges of the pad should rest beyond the limits of the tumor, while the hollow supports its body. This is a contrivance of uncertain advantage. Patients may be comfortable, but there is danger from descent of fresh viscera or injury to the contents. This applies to herniæ of moderate size. In larger ruptures some form of bag suspended from the shoulders gives the most relief, and is practically all that can be done. When the case is recently irreducible (a few days or weeks) it may be treated successfully by rest in bed with the hips elevated, a low diet, the application of an ice-bag, with one or two attempts

daily to push the contents back (taxis). If the patient be intelligent and experienced in reducing the rupture, some of these efforts may be made by himself. They should be of only a few minutes' duration, and never violent. If there be an evident accumulation of fluid in the sac of an epiplocele, it is proper to remove it by aspiration with a fine needle. Compression of the sac with rubber bandages, the use of iodide of potassium to promote absorption of the fat, and "anti-fat" medicines have all been advocated with an occasional apparent success, but are hardly worth mentioning. A week or two, at the utmost, is all the time that can be advantageously spent in these attempts, for they are uncertain, tedious, and of doubtful efficacy.

Results of Mechanical Treatment.—Whatever form of mechanical treatment be adopted, the results are better in inguinal than in femoral irreducible hernia. The success depends upon perseverance, as is shown by an analysis of Macready's table. Of 85 cases of inguinal hernia, 53 were reduced on an average, in 51.8 days, and 32 on an average, in 2.8 years. Of 67 cases of femoral hernia, 18 were reduced on an average, in 75 days, and 49 on an average, in 3.9 years. These results justify the surgeon in recommending operative treatment in cases where no contraindications exist.

Operative treatment by one of the methods for radical cure is the most satisfactory, and it should be applied to all cases except (1) very recent ones where the above-mentioned measures may be first tried; (2) cases of old and voluminous epiplocele; (3) all cases in patients who are debilitated by age (fifty to sixty years and over) or by disease of the thoracic or abdominal viscera. Voluminous epiploceles offer little difficulty, and we have operated on several with success which presented evidence of chronic nephritis, but the operation is attended with risk, and the disability and discomfort must be extreme to warrant the operation. Large enteroceles, on the other hand, present great difficulties from the presence of adhesions between loops of intestines, the separation of which is tedious and fraught with risk from hemorrhage and subsequent shock or peritonitis. It has been recommended that the adherent loops be reduced en masse. The incision into the parietes sufficient for this will be free enough to render a relapse of the rupture almost inevitable. In the case of the cæcum and sigmoid flexure, when no true sac is present the operation is not contraindicated in our opinion, but it will be found more difficult and less certain in its results. In its application to irreducible hernia the radical-cure operation finds its strongest hold on surgical practice. It is nearly as safe as in reducible cases; it offers a prospect of cure; and in the event of relapse the rupture is controllable and the patient free from discomfort and with less risk of accidents.

OBSTRUCTED HERNIA.

An irreducible hernia, in which the passage of fæces is interrupted without disturbance of the circulation, is called obstructed or incarcerated. This occurs generally in umbilical or large scrotal herniæ. An accumulation takes place from constipation or the temporary constriction of the bowel by peritoneal bands within the sac. If unrelieved, this accumulation increases and causes a venous congestion, which may go

on to gangrene of the bowel. The hernial tumor is increased in volume and feels heavier. Impulse is generally preserved, at least at the neck of the sac, and in some instances the finger can be passed into the still patent orifice by indenting the coverings. There is no decided pain, but slight tenderness, and no tension of the contents. With the constipation patients complain of headache, and have a coated tongue and increased sensations of fulness and weight in the hernia. There may be slight colicky pains, nausea, and vomiting before the bowels are evacuated. There is no fever. These phenomena are of one or two days' duration, and pass off with a free movement of the bowels. They may persist, and even go on to those of strangulation; the vomiting is repeated, the constipation persists, there are prostration and an increased pulse-rate, with pain in the swelling, which becomes tense and tender and loses its impulse. Repetition of the vomiting and a failure to respond to enemata or a laxative should, even in the absence of other signs of strangulation, make one apprehensive of that accident. Patients should be carefully treated, for some one of these attacks is likely to imperil life.

Treatment.—Efforts at taxis are injudicious and likely to do harm. Gentle kneading and massage of the hernia and the abdomen may stimulate peristalsis and help unload the intestine, but this is to be avoided if there be tenderness. The patient should rest in bed, with hips elevated, and the hernia supported by cushions and bandages, so as to assist the venous circulation, and warm applications made. Opium is to be administered only to relieve pain; the tenderness and discomfort may be allayed by codeine, chlorodyne, trional, or bromide of potassium. Fluid diet is to be prescribed. At the earliest possible moment high enemata of water, with the addition of castor oil or olive oil or ox-gall, are to be given through the rectal tube and repeated after a few hours. If a movement follows, with evident diminution in the volume of the tumor, calomel followed by salines, or the salines alone, should be administered. Cathartics should not be given at the outset. If the intestinal obstruction persist, herniotomy should be done.

INFLAMED HERNIA.

An irreducible hernia may become inflamed from forcible or prolonged taxis, from the pressure of a truss, fecal obstruction, enteritis, or contusion. In the last event rupture of the intestine has been known to occur. Constriction of the contents at the neck of the sac may cause inflammation, or the contents, inflamed from any cause, may become strangulated from increase in volume and venous congestion. Inflammation is most frequently seen in femoral epiploceles, and then in scrotal and umbilical herniæ containing both gut and omentum. Its features are those of peritonitis limited to the hernial sac. The contents of the sac are swollen, congested, and surrounded by a varying amount of bloody and turbid serum. The omentum is softer and more pliable than normal, and there may be, especially in femoral epiploceles, but a small portion engaged in a sac which is distended with fluid. After the absorption of the fluid, adhesions of varying density and area are formed between the contents and the sac. Resolution with adhesion

usually occurs in epiploceles, though suppuration has been met with. The inflamed intestine is in danger of gangrene or strangulation unless resolution occurs promptly. Inflamed hernial sacs have been met with containing only fluid.

Clinical Features.—The hernia enlarges and feels hot and tender, and is very painful. If there be much fluid, it is tense and semi-fluctuating. Imprisoned omentum with little fluid gives an irregular outline. The impulse on coughing can be usually appreciated, and the tension at the neck is less than in strangulated hernia. With these local changes there is a slight febrile movement, with nausea and constipation, but rarely vomiting. The constipation is not a feature in epiploceles, and not infrequently the local signs only are present. The average duration of symptoms is about one week. In the event of gangrene of the bowel or suppuration in the sac the skin over the hernia becomes reddened and the subcutaneous tissue œdematous.

In large scrotal irreducible herniæ which become inflamed there is so much risk of gangrene that both the local and general symptoms must be carefully watched.

The **treatment** consists in rest, the application of ice, use of a fluid diet, and the administration of opium sufficient to relieve pain. With old persons ice must be used with caution. An enema may be given at the outset, even if there be no constipation. Cathartics and laxatives should not be administered till pain and tenderness are absent. Any indication that the inflammation is going on to strangulation should be met by prompt incision of the sac and the management of its contents as directed in herniotomy.

STRANGULATED HERNIA.

A hernia is said to be strangulated when it becomes irreducible, with not only obstruction to the passage of the fecal contents of the imprisoned loop of intestine, but interference with its circulation.

Causes.—An unusual effort of any kind, a blow or fall, violent coughing, straining at stool, heavy lifting, are among the most common causes of strangulation in a hernia previously *reducible*. In *irreducible* hernia strangulation may result from inflammation or engorgement of the contents, from adhesions in the sac, from bands of adherent omentum, or from twisting of a loop of bowel in the sac. Very rarely strangulation may occur synchronously with the first appearance of the hernia, especially in the femoral region. One such case has been observed at the Hospital for Ruptured and Crippled.

Mechanism.—The early surgeons, from the time of Celsus until the last century, all believed strangulation due to an accumulation of "hardened fæces" in the loop of bowel occupying the hernial sac. Lavater, in 1672, was the first to regard this theory alone insufficient to explain all the phenomena, and he brought forward inflammation of the bowel as an additional cause. The old theory of fecal accumulation continued to be held long afterward, until Sharp and Malgaigne showed it to be without rational foundation. The fact that in nearly all cases of strangulation the small intestine rather than the large was found in the sac furnished sufficient evidence that "hardened fæces" could not be the cause

of the trouble. Various modern theories have been advanced, but only two are of sufficient importance to be mentioned here.

The *elastic-compression* theory explains, in a measure, the varying conditions in a strangulated hernia. Starting with a narrow hernial orifice, by some unusual intra-abdominal pressure or expulsive effort a loop of bowel is forced through the orifice into the yielding sac beyond. The constricting band or ring, consisting usually of the dense fibres of the aponeurosis of the external oblique in the inguinal, and Poupart's ligament in femoral, hernia possesses more or less elasticity, and as soon as the intra-abdominal pressure ceases by virtue of this elasticity the ring returns to its former size. The result of this is compression of the loop of bowel engaged. Venous congestion quickly follows, and the resulting exudations of serum still further increase the volume of the hernia and render reduction more and more difficult. If the constriction be not relieved in time, gangrene of the bowel follows.

Theory of Fecal Occlusion.—Leaving out of consideration various details, the principle is the following: given a hernial sac containing a loop of intestine, which by some unusual strain has been forced through a comparatively narrow hernial aperture, "strangulation" is brought about not by "elastic compression," but by fluid fæces and gas being forced from above into the loop in question through increased peristaltic action. The fæces, once in the loop, cannot be expelled on account of the diminished peristalsis, or even entire absence of peristalsis due to compression.

It is quite possible that some cases of strangulation are due to a combination of both of these supposed causes, yet the majority can be explained more simply on the theory of venous congestion.

Theory of Venous Congestion.—The walls of the veins being more easily compressed than the walls of the arteries, blood continues to be pumped into the loop of imprisoned bowel after its mode of return through the veins has been cut off. This gives rise to the great engorgement always seen in strangulated hernia, and renders reduction difficult.

Pathological Anatomy.—The name conveys an incorrect idea, as it gives a notion of complete strangulation, as, *e. g.*, a loop of intestine constricted by a rubber band. This would suddenly cut off all circulation, which does not happen in a strangulated hernia. The hernial orifice is almost always large enough to admit the finger, so that circulation is gradually and not suddenly cut off, the rapidity of the process depending on the relative size of the orifice and the intestine or omentum occupying it. There is no active contraction or spasm on the part of the neck of the sac: the constricting effect is brought about by the changes which take place in the loop of bowel engaged. These changes are most marked at the site of the neck of the sac.

The external ring plays an important part in the constriction in inguinal hernia, and many authorities have regarded it as the principal factor in producing strangulation. Berger,[1] who has investigated this point very fully, proved that the neck of the sac, when dissected free from the external ring, was capable of considerable dilatation, and his conclusions were that the neck itself was "rarely capable of forming a veritable stricture." Macready states that "it is probable that the seat

[1] *Arch. gén. de Méd.*, 1876, ii. 208.

of the stricture is more often at the neck of the sac in inguinal hernia, and at the fibrous ring (Gimbernat's ligament), outside the neck, in femoral hernia."

Effects of Strangulation.—The first effect is obstruction to the venous return, the veins being less resisting. This is followed by a deep congestion of the gut, causing it to assume a bluish, mahogany, or purple color. Exudation into the sac soon follows, and signs of inflammation appear. The exudation, which at first is clear, later becomes turbid, and the tissues outside the sac become infiltrated and œdematous, and finally, unless the constriction is relieved, gangrene of the gut takes place. This may comprise the entire knuckle or be localized in spots as to the position where the gangrene is most likely to occur. Reichert[1] has examined 25 cases of gangrene with the following result: In 5 cases the whole loop was gangrenous; in 4 the gangrene was found at the site of constriction; in 9 it was located in the convexity of the loop; and in 7 both the site of constriction and the convexity were involved.

General peritonitis may follow, or adhesions may form above the ring, shutting off the general cavity. The tissues about the sac may become inflamed and suppurate, and in rare instances a fecal fistula is established by nature, by means of which the gangrenous intestine is thrown off and recovery may follow. The omentum seldom becomes gangrenous, perhaps owing to the absence of bacteria, which probably play an important part in producing gangrene of the bowels. Ljunggren[2] found bacteria in the fluid contained in the hernial sac in 3 out of 9 cases. Of 39 cases investigated by others, in 27 the fluid contained no bacteria.

Gangrene may occur shortly after the beginning of strangulation or it may be deferred for many days. The earliest time in which it has been observed is four hours. Berger[3] reports a case of gangrene of seventy-two centimeters of intestine after ten hours' strangulation. Other cases have been observed in which strangulation had existed upward of two weeks without gangrene, yet all of these cases resulted fatally.

The symptoms are very similar to those of intestinal obstruction, and when they exist one should at once examine all sites where external hernia may occur.

The first symptoms are, as a rule, local and referable to a tumor which is irreducible. This tumor becomes painful, tense, and tender to pressure, especially if applied over the neck. No impulse, or at most a very slight impulse, is produced by coughing. If seen at an early stage, the tumor is resonant, but later, owing to an exudation of fluid in the sac, the resonance gradually disappears.

Pain is an early symptom. Though at first it is localized in the tumor, it is soon felt in the abdomen, and is frequently referred to the epigastrium. It is severe in character, comes on in paroxysms, and may cause faintness, nausea, and vomiting.

Vomiting is the most important of all the symptoms. It recurs at more or less frequent intervals until the strangulation is relieved or until

[1] *Die Lch. v. d. Bruch Eingkl.*, 1886, 175.
[2] *Rev. internationale de Bibliographie*, Beyrouth, March 10, 1894.
[3] *L' Union médical*, 1879, xxvii. 1055.

death occurs. At first the vomitus consists of the contents of the stomach, but later it contains bile, mucus, and finally fecal matter from the small intestines.

Constipation.—This is usually absolute, and is a symptom of great importance in diagnosis. A small stool may be obtained by an enema or even by a purgative, but this is simply due to emptying the bowel below the point of constriction. In a few recorded cases diarrhœa has been an early symptom of strangulation. In cases where only a portion of the calibre of the bowel is strangulated constipation is present in about 50 per cent.

A slight rise in temperature is seen in most cases of strangulation, except in the later stages, when the temperature may become subnormal. The pulse-rate is increased in frequency always, and becomes thready and "wiry" when peritonitis ensues. The pain and the inability to retain nourishment cause marked prostration.

If the strangulation is not relieved, the pain increases in severity and is chiefly abdominal; the vomiting persists and becomes fecal in character; prostration becomes extreme, the surface cold, the pulse small and feeble, and the patient dies in collapse.

Course and Modification of Symptoms.—In case of sloughing or gangrene there may be local signs of abscess, the tumor may again become tympanitic, and the cellular tissue may give a crepitation due to emphysema. This is more likely to occur in the large herniæ of old people. In the event of a local peritonitis, with abscess and discharge externally, the symptoms do not go on to absolute collapse. Gradual improvement may follow, and, an artificial anus having been formed, recovery may ensue. This favorable issue is, however, rare, but it is met with in femoral hernia more especially.

In omental hernia the symptoms are less marked, but the condition is by no means free from danger. Constipation may be overcome with an enema. Vomiting is not so conspicuous, and may even be absent; the pain and the local phenomena are as significant as in intestinal strangulation.

In partial enterocele (Littré's hernia) vomiting is likely to persist, while the constipation is relieved by treatment, but the local signs remain the same.

Diagnosis.—In strangulated hernia there is loss of impulse, pain, tension, and tenderness, vomiting and constipation, and marked prostration. In obstructed hernia the impulse is preserved, pain is moderate, tension is lacking, tenderness is absent; vomiting, constipation, and constitutional prostration are not marked or yield readily to treatment. In an inflamed hernia impulse is generally preserved; pain and tenderness exist without tension; vomiting, constipation, and constitutional symptoms are trifling in severity.

There is no difficulty in diagnosis in typical cases; doubt will sometimes exist in cases of strangulated omental hernia or partial enterocele. It is always best to give the benefit of the doubt to the diagnosis of strangulation, and act accordingly. It is better to follow this plan than to wait for time to make the diagnosis. In cases presenting the features of intestinal obstruction it is wise to examine all sites of both common and rare forms of hernia. In fleshy people small hernial protrusions may escape a superficial observation.

Prognosis.—If left untreated, the average duration of life is about seven days. Recovery is so exceptional that it may be looked upon as one of those conditions in which the life of the patient is absolutely in the hands of the surgeon. Delay or injudicious treatment may cause a fatal and speedy termination. Cathartics should be strongly condemned. *Promptness* is the cardinal principle in the treatment of strangulated hernia.

Treatment.—The contents must be returned into the abdomen or the hernia made reducible by manual pressure (taxis) or by operation (herniotomy).

(1) Taxis is the term applied to manual force used in attempting to reduce a hernia;

(2) Herniotomy consists in an open incision, exposure and division of the constricting tissues, and reduction of the contents of the sac.

Certain preliminary measures may be employed, but these should never be persisted in beyond a few hours; *e. g.* rest, restriction of food, the administration of stimulants and opium, and the application of ice to the hernial tumor. Elevation of the pelvis and flexure of knees may be of service in aiding reduction. The warm bath has been extensively used, and it is still advocated by many surgeons. The external application of ether has been used by some surgeons with good results. The only objection to these adjuvants is the time they require, and unless one can be sure of the condition of the bowel the delay may be dangerous.

Simple taxis should be tried first, except under conditions mentioned as contraindications. If this fail, the surgeon may after a short interval make a second effort. If this prove unsuccessful, taxis under anæsthesia should be resorted to. Before doing this, preparations for operation should be made, so that, in the event of failure, herniotomy can be performed without delay, or the necessity of subjecting the patient again to an anæsthetic.

Mode of Performing Taxis.—Position of the patient.—In inguinal hernia the pelvis should be elevated and the thighs flexed. In femoral, the thigh should be flexed and slightly rotated inward. In umbilical, both thighs should be flexed so as to relax the abdominal muscles to the fullest extent. An advantage is sometimes gained by "inverting" the patient, as it is termed, placing the head and shoulders on the floor while the pelvis rests upon a table or couch.

The surgeon should grasp the neck of the sac with the left hand, and then make careful lateral compression over the fundus with his right hand. Special movements have been recommended, but it may be doubted if they have any especial value. Traction on the tumor, followed by pressure, will often aid in reduction. Alternate pressure with the left hand over the ring, and with the right over the fundus, will often succeed. Taxis should not be employed longer than three to five minutes in enteroceles; it may be a trifle more prolonged and more forcible in epiploceles.

Failure to reduce the bowel may depend upon effusion in the sac or on effusion or gas in the bowel itself. Some surgeons have advised aspiration to overcome these conditions. Hern has reported 33 cases aspi-

rated with a fine hypodermic syringe, and in 29 of these reduction was accomplished. He advises it only in cases where strangulation has existed a short time and which refuse operation. It is a measure of doubtful advantage.

Signs of Reduction.—If the taxis is successful, the imprisoned intestine slips up into the abdomen suddenly, while the omentum slides away more slowly. The hernial tumor disappears, and the finger, passed into the canal, finds it empty. The relief of pain is almost instantaneous, vomiting ceases, and after a varying time fæces and gas are passed per rectum.

After-treatment.—So soon as reduction is accomplished a pad of gauze or lint or cotton should be placed over the hernial orifice, supported by adhesive plaster or a bandage. Occasionally the truss previously used may be replaced. The patient should be kept recumbent until the abdominal pain and tenderness have subsided, all constitutional disturbance has disappeared, and until the bowels have moved naturally.

Accidents and Dangers of Taxis.—By too forcible or too prolonged efforts the bowel may be lacerated or ruptured, or so severely contused as

FIG. 102.

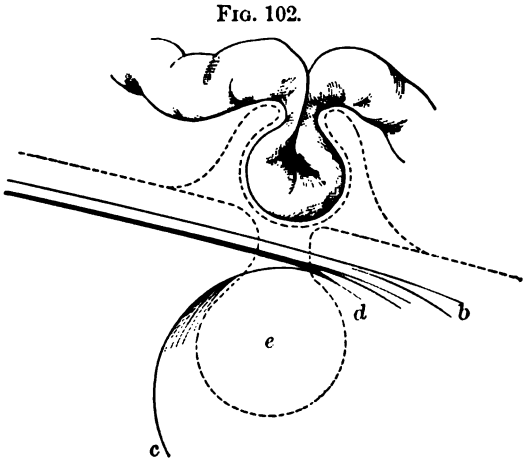


Diagram illustrating reduction of the sac in femoral hernia (Roser).

to hasten the process of gangrene. There is risk, too, of peritonitis from squeezing into the abdominal cavity some of the infected fluid of the sac. The sac may be ruptured (Fig. 104) and the contents forced out into the subcutaneous tissue; the sac itself may be reduced with the bowel still constricted at its neck in femoral hernia (Fig. 102), or the contents may in case of an inguinal properitoneal hernia (see p. 000) be merely forced from the lower into the upper segment of the sac, as illustrated in Fig. 103. These different anatomical conditions cannot all be clinically recognized. They may, for practical purposes, be included under the head of "an apparent reduction." The hernial tumor is apparently reduced, but after a few hours the symptoms of strangulation reappear in the form of continued prostration, vomiting, pain, and tenderness or fulness about the hernial site. Under these circumstances the

abdomen should be promptly opened by a vertical incision over the hernia or in the median line, and the constricted gut released.

FIG. 103.

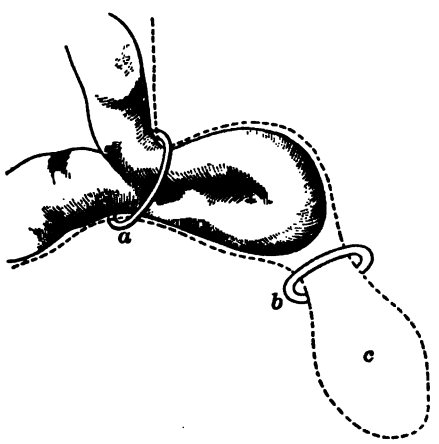


Diagram illustrating "apparent reduction" of a strangulated hernia: *a*, internal abdominal ring; *b*, external abdominal ring; *c*, empty scrotal part of sac (Roser).

That the above are practical dangers is proved by the deaths that occur after successful taxis. Bryant[1] states that 3.8 per cent of ingui-

FIG. 104.

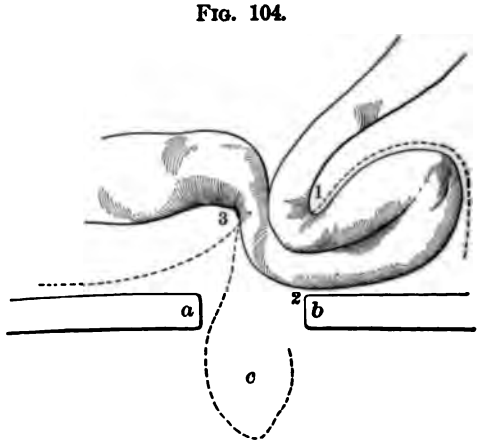


Diagram illustrating rupture of sac (Roser).

nal hernias that have been reduced by taxis prove fatal. Frikhoffer[2] gives even a higher mortality—14.9 per cent. in 308 cases of femoral hernia, and 7.8 per cent. in 518 cases of inguinal hernia.

The significance of taxis has materially diminished since abdominal operations have proved so successful, and it is no longer judicious to persist in it to the extent that was countenanced by the practice of

[1] *Clin. Surgery*, pp. 212–215.
[2] *Medicin. Jahrb.*, Nasson, 1861, xvii. 439.

twenty years ago. It is not going too far to look upon it as an adjuvant to herniotomy, and to resort to it only when all preparations for operation can be promptly made.

Contraindications to Taxis.—It is unwise to attempt taxis if previously to strangulation the hernia has been irreducible, as in many cases of umbilical hernia; if there be present symptoms of inflammation or gangrene or general peritonitis; and if, in general, the strangulation has lasted for twenty-four hours.

Herniotomy, or *kelotomy*, should be performed when taxis has failed or in cases where it is contraindicated. If possible, it should be done during the same anæsthetic séance. It is a justifiable and imperative operation even in conditions of extreme prostration. Most surgeons of experience have witnessed cases that seemed to be moribund which have undergone successful operation. Success in this operation is directly proportionate to its early application. With the diminished mortality of aseptic operations it may truly be said that herniotomy is a less dangerous procedure than taxis indifferently or indiscriminately applied. It has been successful under cocaine anæsthesia, and even without any anæsthetic in cases of great prostration. The operation consists of the following steps:

First Step.—Exposure of the sac and opening it. An incision two or three inches in length should be made over the neck and upper part of the body of the sac parallel to the long axis of the hernia, and with a director or two forceps layer after layer of tissue should be divided until the peritoneum is reached. This may be recognized, first, by the presence of the subperitoneal fat immediately outside it; second, by its lead or bluish color; third, by its gliding over the contents of the sac beneath it. The sac, once recognized, must be in all cases opened, the edges retracted, and the contents examined. It will usually be found to contain a little fluid, the character of which should be noted as it escapes. This fluid is clear or bloody and without odor when the gut is merely congested. It is turbid and still odorless when inflammatory changes have begun. It is putrid and contains flakes of fibrin—sero-purulent when the intestine is gangrenous.

The *second* step consists in a division of the constricting neck, and returning the contents of the sac to the abdominal cavity. In all cases the constriction is to be divided; the contents are to be returned or not according to the condition in which they are found. To divide the constriction the finger or a broad director should be passed up to the neck of the sac, and the contents, whether intestine or omentum, held out of the way. With an ordinary bistoury or hernia knife passed upon the director or the palmar surface of the finger the constriction at the neck is to be divided, in general in an upward direction. A free cut is to be avoided; the incision should consist rather of a series of nicks, only sufficient tissue being cut through to permit the constriction to be relieved. If the contents (bowel or omentum) be in good condition, they are to be returned to the abdomen by direct pressure. If gangrenous, they may be left in place or resected.

The *third* step consists in closure of the wound over a small tampon of iodoform gauze. In many cases the attempt at radical cure may be made at this stage in accordance with procedures elsewhere described.

Management of Contents.—Great gentleness should be used in the manipulations for the return of the extruded contents, and the viscera should be kept warm by free ablution of sterilized saline solution. The intestine may be said to be in good condition when its serous coat is still smooth and glistening; when it is red or purple, or even mahogany in color; when it has a firm, elastic feel; when it is warm, or becomes warm, a few seconds after the constriction has been divided; and when the fluid contained in the sac is clear or bloody and odorless. It is, on the other hand, bad or doubtful when its peritoneal coat is granular or lustreless; when it is black in color, flabby, and œdematous to the feel; remains cold after exposure and after division of the constriction; and when the fluid contained in the sac is putrid or sero-purulent. Reduction is sometimes difficult, owing to the slippery character of the loops of the intestine. It is a good plan to first squeeze out the air in the strangulated loop, and then to push back the loop itself; existing adhesions may be separated or cut through, but all bleeding points should be carefully secured by ligature. Notwithstanding the above distinctive features of good and bad conditions, one will sometimes be in doubt as to the best course to pursue. In these cases of doubt it is probably better not to return the intestine, but to permit it to remain in place, protected by a proper bandage, after the constriction has been removed, until a few hours' exposure will have determined whether it has vitality enough to be safely returned to the abdomen. Small perforations may be closed with suture and the otherwise healthy bowel returned. A gangrenous knuckle must be either left in place or the operation of resection undertaken. When left in place, there is no need of sutures; adhesions in the neighborhood of the neck are sufficient to hold the intestine in place. One must be sure that the constriction is divided, so as to permit a passage of the intestinal contents, but should interfere with the adhesions as little as possible. The gut should be opened and the whole operation-wound fully protected with an antiseptic dressing. Some surgeons prefer to remove the gangrenous knuckle and to form an artificial anus by sewing the cut ends of gut to the skin.

A resection, if undertaken, must be done through a portion of the intestine somewhat removed from the seat of constriction, so as to ensure the application of the sutures to perfectly healthy bowel. For this purpose the hernial orifice may be enlarged sufficiently to permit the loop of the intestine to be drawn out of the abdomen and carefully isolated by sterilized gauze; resection is then performed by the usual procedure, by a circular suture, or by Murphy's button. Several feet of gangrenous intestine have been in this way removed with success. Much discussion has arisen as to which is the better plan in gangrenous cases—to leave in place and wait for the formation of the artificial anus, to be closed by a secondary suture of the intestine, or to perform the resection as a primary operation. Of the numerous statistics offered in support of the one plan or the other, we note the following:

Mikuliez[1] collected, in 1891, 173 cases of gangrenous hernia from the larger German hospitals: 94 were treated by artificial anus, with a resulting mortality of 76; 67 were treated by primary resection, with

[1] *Cent. f. Chirurg.*, 1891, 944.

a mortality of 47 per cent. McCosh[1] collected 115 cases of primary resection, with a mortality of 50 per cent.

Statistics, however, are not capable of demonstrating the preference to be given to the one or the other procedure: much must be left to the judgment of the operator, his estimate of the patient's condition, and much more depends upon his technical skill in such an operation as resection. In general, it may be said that a primary resection may be judiciously undertaken in a patient whose condition is good enough to warrant the addition of a second prolonged operation to the one already performed for the relief of strangulation. There may be more reason for doing it if the amount of intestine to be removed is small, and if the operator has had sufficient experience to enable him to conclude this delicate operation with rapidity and precision. On the other hand, in patients who are depressed or prostrated at the close of the incision for the relief of strangulation, or where the amount of intestine to be removed is large (several feet), or where the operator is inexperienced, it is undoubtedly safer to leave the gut in place, to be treated subsequently by secondary resection. It is worthy of note that a large number of cases, especially of femoral hernia, are on record where the artificial anus or fecal fistula has closed spontaneously.

Management of Omentum.—If it be small in quantity or little damaged by inflammatory changes, and with good circulation, it may be returned. If it be large in quantity, thickened, and inflamed, and its vitality threatened, as shown by loss of temperature and extravasated blood, and if by the separation of adhesions its surface be left raw and bleeding, it is best to ligate it where it is healthy and to return the stump. This is best done with a chain ligature of medium-sized catgut, in the application of which one should be sure not to go nearer than an inch or an inch and a half to the transverse colon. In removing the omentum care should be taken not to cut within half an inch of the chain ligature.

The radical cure of the hernia may be attempted after the operation for strangulation is completed. This adds little or nothing to the risk of the previous operative steps, and should always be done, except in patients who are in a very prostrated condition. The after-treatment is similar to that after all operations on the intestine. Accidents in course of the operation, or a hemorrhage from a wound of the vessels in the neighborhood of the neck and in the separation of adhesions, can be averted with care, but all bleeding points, especially in parts that are to be returned to the abdomen, should be most carefully scrutinized. A wound or tear of the intestinal wall is sometimes unavoidable, but it should be sutured at once.

Prognosis.—Operations undertaken early, before gangrene or perforation has occurred, are attended with little risk. Later operations may be fatal from shock, from peritonitis, which is present at the time the operation is undertaken, or from subsequent complications. The earlier the operation is undertaken, the greater the chance of success.

Complications.—A local peritonitis may occur about the wound, but this is usually conservative in character and not attended with more than local symptoms. There sometimes occurs intestinal obstruction

[1] *N. Y. Med. Journ.*, 1889, No. 49, 281.

from formation of adhesions, from kinking of the bowel, or from its strangulation by bands of omentum. This condition is an indication for immediate laparotomy. Shock causes the death of some patients, especially when the operation has been performed at a late moment. General peritonitis from rupture of the returned bowel is inevitably fatal. A paralysis of the bowel (the portion which has been strangulated) sometimes occurs, especially in old people. It gives rise to phenomena of obstruction—enteritis characterized by pain, diarrhœa, sometimes vomiting, abdominal tenderness—and demands only medical treatment.

Mortality after Herniotomy.—In 382 cases treated from 1822 to 1858, Frickhoffer found a mortality of

19.4	per cent.	in cases	strangulated	1	day or less.
49	"	"	"	2	days.
40.9	"	"	"	3	"
50	"	"	"	4–5	"

Habs and Reichel have analyzed 129 cases operated upon aseptically, with the following results:

Mortality of	12.5	per cent.	in cases	strangulated	1 day.
"	26.1	"	"	"	2 days.
"	36.3	"	"	"	3 "
"	44	"	"	"	4 "

The improvement in the latter class is less marked than one would suppose, but in operations for strangulated hernia there is seldom sufficient time to enable the surgeon to carry out the usual technique to render the field aseptic. The age of the patient has some bearing on the prognosis. The chances of recovery are greatest between the ages of twenty and thirty years, while after fifty years the mortality is doubled.

The most recent statistics on the results of operation for strangulated hernia are those of Henggeler,[1] founded upon an analysis of 276 cases treated at the surgical clinic of Krönlein at Zurich between the years 1881 and 1894. These cases have been grouped according to the method of treatment employed. From 1881 to 1884, when carbolic acid was used for antiseptic purposes, the mortality was 38.15 per cent. From 1884 to 1892, when corrosive sublimate was used, the mortality was 21.1 per cent. From 1892 to 1894, in 49 cases operated upon by aseptic methods, the mortality was 16.2 per cent. The mortality of the different varieties of hernia was as follows:

Of 111	inguinal,	21 deaths,	18.9 per cent.
" 159	crural,	38 "	23.9 "
" 4	obturator,	4 "	100. "
" 2	umbilical,	1 "	50. "

STRANGULATED HERNIA IN INFANTS.

Surgical text-books scarcely refer to strangulation in infants, for the reason that it has been regarded as too rare to possess any practical importance. The recent researches of Tariel and Stern, however, show

[1] *Deutsch. Zeit. f. Chir.*, 1895, B. xv. H. 1, p. 1.

that it at least deserves brief mention. Stern made an analysis of the records of the children's hospitals at Basle, Prague, Breslau, Vienna, Krakow, Frankfort, Amsterdam, Bern, and Göttingen.

Of 139,000 children treated, there was not a single operation for strangulated hernia. He also analyzed 1900 herniotomies performed at various European hospitals, and found 13 to have been on infants (under four years of age). Stern has added 51 cases to the 87 previously collected by Knobloch. These cases include only inguinal hernia. Of the 51 cases collected by Stern, 11 were cæcal: 70 per cent. of the cases occurred during the first year of life. Five cases under two years of age were operated upon at the Hospital for Ruptured and Crippled between the years 1891 and 1895, without a single death.

The mortality is lower than in adults. In the pre-antiseptic period it was $33\frac{1}{3}$ per cent.; in the antiseptic period, 20 per cent., or, ruling out the cases in which death was not due to the operation, it was 13.6 per cent., which compares favorably with the adult mortality of 18.9 per cent. based upon 733 cases operated upon during the antiseptic period. In 14 cases of strangulated umbilical hernia in infants the mortality was 50 per cent.

Special Herniæ.

INGUINAL HERNIA.

Definition.—Hernial protrusions emerging through the inguinal canal are termed "inguinal." If they occupy the canal alone, they are "incomplete" (bubonocele); if they pass into the scrotum, they are "complete" or "scrotal." They are subdivided into two classes—oblique or indirect and direct—according to the position of the neck or orifice with reference to the epigastric artery.

In the oblique or common form the neck is external to the epigastric artery; that is, the hernial sac comes out of the internal ring at a point outside of the epigastric vessels, and, passing downward and inward to the external ring, crosses the epigastric almost at right angles. In the direct hernia the hernia does not come out at the internal ring, but forces its way directly through the wall, lower down, below and to the inner side of the epigastric vessels. It is not always possible to make out this anatomical distinction in herniæ of large size and of long standing, but the position and shape of the tumor will greatly aid the diagnosis.

OBLIQUE INGUINAL HERNIA.

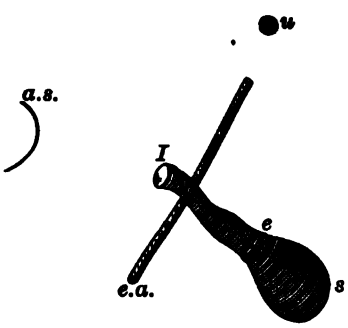
Of all inguinal herniae 93 per cent. are oblique. This variety may be either congenital or acquired.

By *congenital* is meant a hernia in which the sac connects with the tunica vaginalis. Most writers include under congenital hernia cases where the hernia descends into an unobliterated funicular portion of the tunica vaginalis. Inasmuch as such cases cannot be anatomically differentiated from acquired hernia, it would seem better to apply the term "congenital" only to cases in which the contents of the sac are in contact with the testis. A congenital hernia may occur in the female in

cases when there remains an unobliterated process of peritoneum, the so-called "canal of Nuck."

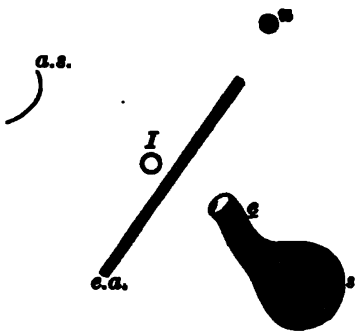
It is impossible to estimate with accuracy the proportion of hernia

Fig. 105.



Indirect hernia (oblique).

Fig. 106.

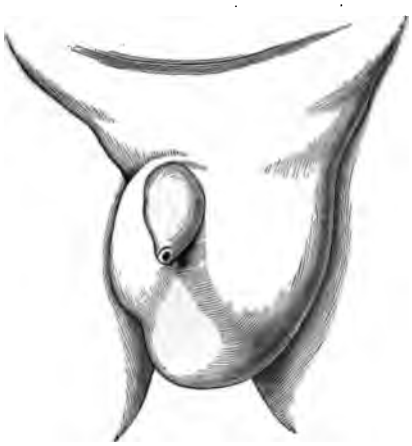


Direct hernia.

u, umbilicus; a.s, anterior superior spine of ilium; e.a, epigastric artery; e, external ring; I, internal ring; s, sac of hernia.

that are congenital, for the reason that the diagnosis cannot be positively made without operation. The majority of the cases occurring during the first years of life are probably congenital. Some authorities state that all herniæ occurring under fourteen years of age are congenital, but this is not true, as shown by the observations at the Hospital for Ruptured and Crippled, based upon 250 cases under fourteen years of age in which operation for radical cure was performed. In a very large number of these cases the sac did not communicate with the tunica vaginalis.

Fig. 107.



Congenital inguinal hernia (scrotal) in child seventeen months old.

Congenital herniæ are usually subdivided into two varieties: 1. When the process of peritoneum is patent the entire length, so that the intestine or omentum may come in direct contact with the testis; 2. When the process of peritoneum, while patent in the upper portion, has been shut off just above the testis.

ACQUIRED OBLIQUE HERNIA.

This variety usually appears in adult life, though it may occur in youth. It is developed far more slowly than hernia of the congenital type, and appears at first as a slight bulging over the internal ring. The canal gradually becomes dilated, and unless properly controlled its tendency is to become scrotal (Fig. 108).

There is a rare form of acquired oblique hernia which has been called "infantile" hernia or encysted hernia. It is of great importance to understand the anatomy of this form, since it not infrequently becomes strangulated.

We have to suppose the funicular portion of the sac connecting with

FIG. 108.

Oblique inguinal hernia, double (after Bougery).

the tunica vaginalis to have been closed at the upper portion—*e. g.* near the external ring. A hernia occurring under such conditions, the sac being formed exactly as in an ordinary acquired hernia, is pushed for-

FIG. 109.

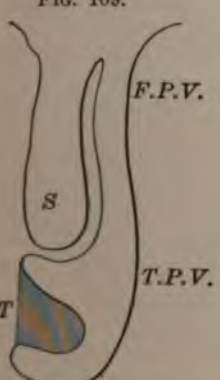
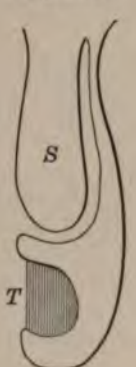


FIG. 110.



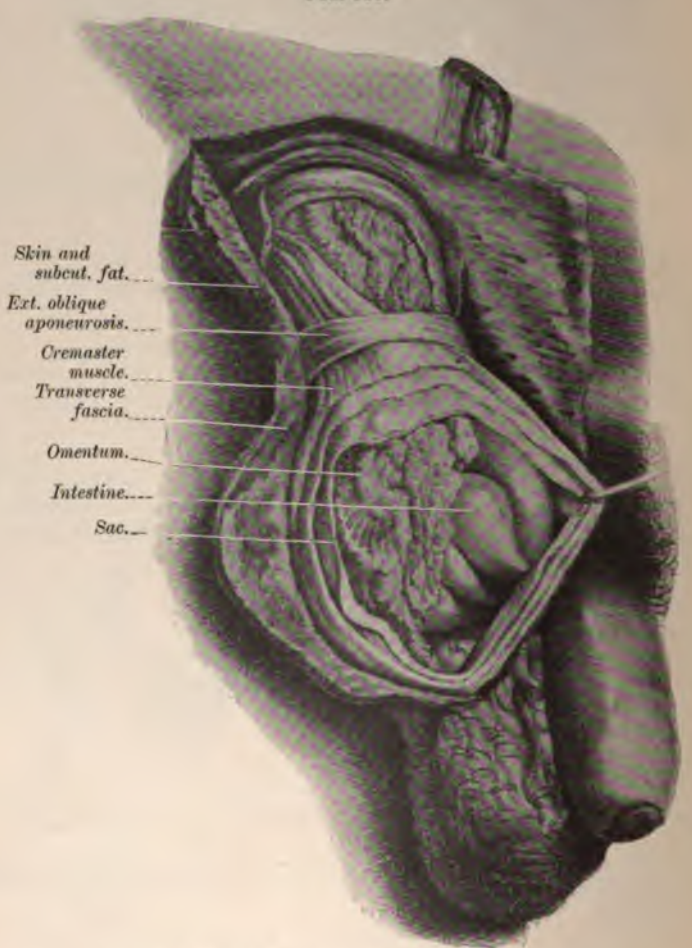
Infantile hernia (after Lockwood): *S*, sac; *T*, testes; *T.P.V*, testicular portion tunica vaginalis; *F.P.V*, funicular portion tunica vaginalis. Fig. 109 shows variety where tunica vaginalis connects with abdomen. Fig. 110 shows no communication.

ward until it meets the unobliterated pouch of peritoneum, making really two sacs, the one within the other (Figs. 109, 110).

Lockwood, who has made a most careful study of infantile herniæ, has brought forward a new theory as to their mode of origin. He believes that the same force that under normal conditions brings down the vaginal process of the peritoneum—viz. the muscular fibre of the gubernaculum —may under unusual conditions bring down a second process of peritoneum, thus producing this variety of infantile hernia. The hernial sac may be entirely free from the serous membrane of the tunica vaginalis, or it may be adherent at the neck or more commonly at the back.

Coverings.—The coverings in an oblique inguinal hernia consist of the peritoneum, the infundibuliform process of the transversalis fascia,

FIG. 111.



Dissection of oblique inguinal hernia (after Bougery).

cremaster muscle, intercolumnar fascia, superficial fascia, and skin. These different coverings possess less interest surgically than anatomically (Fig. 111), although in an operation skilfully performed these layers can all be recognized.

DIRECT INGUINAL HERNIA.

This form is always acquired. It is, more properly speaking, a ventral hernia, rather than inguinal, since it does not pass through the inguinal canal, but through the conjoined tendon and triangular ligament on a level with the external ring. Direct hernia rarely if ever occurs in children. It is far more common in men than women. Compared with oblique hernia, it is much less frequent, occurring in about the proportion of one in seven.

The different position of the sac relative to the cord in direct hernia is of importance, especially in operating for radical cure. In oblique hernia the sac invariably occupies a position *anterior* to the cord, while in direct hernia the cord is usually anterior and to the outer side of the sac.

The coverings of a direct hernia are practically the same as those in the oblique, with the exception of the cremasteric fascia.

The shape of the tumor is quite characteristic in direct hernia, as it is almost always spherical rather than oblong, and it rarely extends into the scrotum.

INCOMPLETE INGUINAL HERNIA.

Diagnosis.—When incomplete or occupying only the canal, the hernia called sometimes "bubonocele" presents these symptoms: pain, tumor, and impulse on coughing.

Pain is the most constant of all symptoms in the early history of a hernia. Macready states that it occurs in 96 per cent. of all cases. The pain may be either acute or dull, and is located at the site of the hernia, as in the back or in the region of the umbilicus. The severe, sharp pains are most likely to occur in the incipient stage of the hernia.

Tumor.—This sign occurs next in order of time, and first appears at the site of the internal ring, except in direct hernia, when it is seen near the external ring. At first the tumor is nothing more than a slight bulging at the site mentioned, augmented by coughing or lifting, and entirely disappearing on lying down. Later it tends to increase in volume and to descend into the scrotum.

Impulse on coughing is a constant and valuable sign, provided the hernia is reducible and the subject is old enough to enable the physician to make use of it. An infant can usually be made to cry, which is a good substitute for coughing.

The swellings in the groin which may be mistaken for incomplete inguinal herniæ are femoral hernia, hydrocele of the cord in the male, hydrocele of the canal of Nuck or cysts of the round ligament in the female, undescended testis, psoas abscess, inguinal adenitis, retroperitoneal adenitis, tuberculosis of the cord, malignant disease of glands, fatty tumors.

Femoral Hernia.—The diagnosis between inguinal and femoral hernia is not usually difficult if we bear in mind the two chief landmarks—viz. the spine of the pubis and Poupart's ligament. In the male, if the hernia is reducible, the external ring can always be made out. The spine of the pubis may be found in the male by pushing the index finger within the canal, invaginating the scrotum, and tracing the external pillar of the ring to its point of insertion, which is the pubic spine. In the female the diagnosis is often difficult and sometimes impossible. When the external

ring cannot be clearly made out, if the adductor muscles are made tense the spine of the pubis should be found just external to the origin of the adductor longus. In fleshy subjects this method will be of little avail, but in such cases careful attention to the fold or crease in the skin, which is very nearly on a line with the spine of the pubis, will be of service in making the diagnosis.

If Poupart's ligament cannot be felt, we may substitute for it a line drawn from the anterior superior spine of the ilium to the spine of the pubis. If the hernia is *above* this line, it is *inguinal*, and if *below*, it is *femoral*.

Hydrocele of the Cord.—This occurs frequently in children, usually under two years of age, though it is occasionally seen in adults. The diagnosis can be made from the peculiar cyst-like character of the swelling, which is generally globular, more freely movable and more tense than a hernial tumor, unless strangulation is present. The upper limits of the swelling are much more clearly defined than in an irreducible hernia.

Hydrocele of the canal of Nuck or of the round ligament presents the same characteristics in the female as those just described. It is much rarer than hydrocele of the cord, and the diagnosis is seldom made except by those who have had large experience in hernia. The condition is usually mistaken for a hernia, but a correct diagnosis will be possible in nearly every case if the following points are observed: The tumor gives a peculiar elastic sensation on pressure; is distinctly located in the *inguinal* canal or can be pushed into the canal; is not reducible, or rarely so; and has no impulse on coughing. These physical signs, added to a history of having originated without apparent cause, of having existed for a considerable time, gradually increasing in size without causing any constitutional and but few local symptoms, make the diagnosis of hydrocele reasonably certain; aspiration by means of a small hypodermic needle may be employed to confirm the diagnosis.

Fourteen cases of hydrocele in the female were observed at the Hospital for Ruptured and Crippled in the years 1890 and 1891.[1] In 1890, Weichselmann[2] collected 62 cases from surgical literature; Coley in 1892 found 16 others, in addition to the 14 cases observed at the Hospital for Ruptured and Crippled, making a total of 92 cases.

Fatty tumors are, as a rule, more superficial, lobulated, and softer in consistence. Careful examination will usually show that the tumor does not emerge from the inguinal canal, but is situated external to the canal.

Lymphatic Glands.—Enlarged glands resulting from inflammation or secondary to malignant disease are very frequently mistaken for hernia, more often for femoral hernia. The diagnosis is not often difficult. The chief points to be remembered are, first, the character of the swelling. If adenitis, the tumor will be more diffuse, the skin often more or less adherent, and not infrequently reddened; the tumor will be rather on a line with Poupart's ligament than the inguinal canal, and careful palpation will usually disclose the fact that it is made up of several small nodules. In the male one should always try to feel the external ring;

[1] "Hydrocele in the Female, with Report of 14 cases," W. B. Coley, *Annals Surg.*, 1892, vol. xvi. p. 42.

[2] "Ueber Hydrocele Muliebrus," von Wilhelm Weichselmann, *Archiv f. klin. Chirurgie*, xl. p. 579.

if this is empty and the tumor is external to the canal, it cannot be a hernia. In case of doubt an examination of the genitals and lower extremities should always be made for a possible ulcer or source of infection.

Psoas abscess may so closely resemble a hernia as to make the diagnosis extremely difficult. The tumor may be exactly in the situation of a hernia; it may disappear on lying down, and may even have a distinct impulse on coughing, but it can almost always be differentiated from a hernia by careful bimanual palpation. The patient should be examined lying upon his back, with one hand placed deeply in the pelvis above the tumor: if firm pressure be made upon the tumor itself with the other hand, instead of reduction into the abdominal cavity taking place, the tumor will still be distinctly felt in the pelvis. This method of examination also demonstrates the presence of fluctuation, an additional sign of great value in making the diagnosis. If *psoas abscess* be suspected, one should make a thorough examination of the spine and pelvis for evidence of bone disease.

A *retained testis* in the inguinal canal may cause nearly all the symptoms of a hernia. The scrotum should always be first examined, and both testes sought for. With a history of a testis never having been in the scrotum on that side, and a tumor in the inguinal canal, somewhat

FIG. 112.

Scrotal hernia.

smaller than a normal testis, but similar in shape, consistence, and, above all, in the sensation on pressure, the diagnosis is reasonably certain. It should be remembered that very many cases of retained testis are associated with a small rupture.

Diagnosis of Scrotal Hernia or Complete Inguinal Hernia (Fig. 112).—The various conditions likely to be mistaken for scrotal hernia are —hydrocele of the tunica vaginalis, hæmatocele, varicocele, tumors of

the testis, œdema of scrotum, and ascites, with a patent processus vaginalis peritonei.

Hydrocele (Fig. 113) is the most frequent source of error in diagnosis.

FIG. 113.

Hydrocele of tunica vaginalis testis.

The chief points wherein a hydrocele differs from a hernia are the following:

It is not reducible, except in rare instances, which will be referred to later. In most cases it is translucent. In cases of long standing, where the tunica has become greatly thickened, the light test is of no service. The tumor seldom extends above the external ring. The history of the case is of importance. In hernia there will be a history of a tumor beginning in the groin, and later entering the scrotum. In hydrocele the swelling is first noticed below in the region of the testis. In reducible hydrocele the diagnosis is more difficult. In reducing the swelling there is a peculiar sensation as of fluid passing through the canal. If the patient be made to stand after reduction, and the pressure of the fingers over the canal be slightly lessened (not enough to permit the bowel or omentum to escape), the swelling in the scrotum will slowly reappear.

Hæmatocele needs scarcely more than mention. In 824 cases of mistaken diagnosis referred to the London Truss Society between 1877 and 1888, but 4 were hæmatoceles. What has already been said in regard to hydrocele will apply to hæmatocele, except that the tumor will not be translucent, and one can usually elicit a history of comparatively rapid formation following a local injury. We have seen one case at the Hospital for Ruptured and Crippled in New York in which the diagnosis was not easy. The patient was a young adult, and had a tumor the size of a large cocoanut, not only filling up the entire scrotum, but extending up into the inguinal canal so far that it was impossible to tell whether or not it communicated with the abdominal cavity. The swelling had appeared two days before, following a kick in the groin by a horse, and developed within a few hours. The patient was sent to the hospital with the diagnosis of irreducible inflamed scrotal hernia.

The fact that there had been no previous history of hernia, as well as the clinical symptoms and character of the swelling, made it possible to rule out the presence of bowel. To have an omental hernia of that size developing so quickly would have been impossible. The history of a severe direct injury, confirmed by the presence of well-marked ecchymosis and distinct fluctuation without translucency, was sufficient to enable the diagnosis of hæmatocele to be made. Aspiration of a bloody fluid confirmed it. In cases of doubtful tumors of the scrotum, where fluctuation is present, if one is assured of the absence of bowel, a small hypodermic needle may be employed to advantage and with safety.

Inflamed Testis.—Next to hydrocele, an inflamed testis is most often mistaken for a hernia. Of the 824 cases of errors in diagnosis observed at the London Truss Society, this affection was the cause in 107 cases. The diagnosis is never difficult, and only requires a careful examination and a moderate knowledge of the important physical signs of a hernia. Though the cord may be somewhat enlarged and tender, the tumor itself is confined to the scrotum and never extends into the canal. The character of the swelling differs very greatly from a hernia; it is much more tender on pressure, and in consistence harder than a hernial tumor.

FIG. 114.

Large varicocele resembling hernia (New York Hospital).

Varicocele.—Although this affection more closely simulates hernia than orchitis, it is a less frequent source of error in diagnosis (90 in 824). A mild case of varicocele confined to the lowermost veins of the cord seldom causes difficulty, but when the entire mass of veins extending beyond the external ring is dilated, the resemblance to hernia may be very great (Fig. 114). The tumor has many of the characteristics of omental hernia. It is reduced on lying down and reappears on standing. In addition, it may have a distinct impulse on coughing. The two points, however, which serve to distinguish it from a hernia are, first, the peculiar character of the impulse on coughing. This, being caused by the forcing of the blood through the enlarged veins, differs greatly from the impulse caused by a piece of omentum or bowel. The second point is the one already referred to in connection with reducible hydrocele: if the tumor has been reduced and the fingers are held over the canal with only sufficient pressure to prevent bowel or omentum from coming down, the swelling will slowly reappear.

Diagnosis of Contents.—The cæcum alone or with the appendix may be contained in the sac. The diagnosis, unless confirmed by operation, cannot, as a rule, be definitely made, yet in some cases, especially in young children, where the overlying tissues are extremely thin, the appendix can often be distinctly outlined. In several cases of this class observed at the Hospital for Ruptured and Crippled the diagnosis made before operation proved to be correct. It is difficult to recognize a cæcal hernia unless the appendix can be felt.

The Ovary.—This condition occurs much more frequently in infants and young children than in adults. In children the diagnosis is not difficult: the only thing likely to be mistaken for it in children would be a hydrocele of the canal of Nuck or a portion of irreducible omentum. Irreducible omentum is rare in children, and hydrocele of the canal of Nuck would show evidence of its cystic character. The ovary is reducible in about 50 per cent. of the cases in children and 15 per cent. in adults (Macready, p. 160). A thin cord may be felt above the tumor and followed up to the internal ring, but this is a more valuable sign in children. In adults the difficulties in distinguishing it from omentum are much greater: vaginal or rectal examination may be of aid, movements of the uterus causing traction on the ovary in the sac. The tumor may also give a history of increase in size and tenderness during menstruation. In somewhat more than one-half of all cases it is associated with intestine.

Small Intestine.—This may form the only contents of the sac or exist with some other structure, usually omentum. Often a tympanitic percussion note or a gurgle on palpation will reveal its presence. In thin-walled herniæ the contained intestine is sometimes felt with great distinctness.

Adherent Omentum.—This condition can usually be readily recognized, yet in some cases it very closely simulates other conditions. The adherent omentum may be either reducible or irreducible.

If *reducible*, the diagnosis can readily be made as follows: First, reduce the tumor; then, with the fingers lightly pressing upon the external ring, make gentle *traction upon the testis*. If the tumor be adherent omentum, the traction on the cord will cause it to reappear, and at the same time, as it slips under the fingers at the external ring, it produces a very characteristic sensation. The adhesions are usually in the fundus of the sac and not often at the neck. They vary greatly in density from delicate membranous filaments to thick fibrous bands.

Irreducible adherent omentum is simply a later stage of the condition just described. With the lapse of time the adhesions increase in number and firmness, more and more omentum finds its way into the sac, and finally the irritation of an imperfectly fitting truss produces a gradual hypertrophy of the omentum, until it can no longer be reduced. The history of a previously reducible hernia and the character of the tumor itself usually render the diagnosis of irreducible omental inguinal hernia not very difficult.

Changes that may take Place in Imprisoned Omentum which may Obscure the Diagnosis.—The omentum may become so hard from chronic inflammation that it simulates an enlarged gland. The position alone will usually render the distinction easy. A certain amount of effusion into the hernial sac, communication with the abdominal cavity having

been shut off by adhesions, may cause the swelling very closely to resemble a hydrocele of the cord. If a close examination of the canal itself cannot settle the diagnosis, aspiration with a small hypodermic needle will be sufficient. If after the withdrawal of all or a portion of the fluid no mass can be felt, we know that we have to deal with something other than omental hernia—viz. either a hydrocele of the cord or a hydrocele of an empty hernial sac.

Tuberculosis of the cord may be mistaken for reducible inguinal hernia. A case in which the diagnosis was extremely difficult was observed at the Hospital for Ruptured and Crippled in 1894.[1] Exploratory operation by Dr. Bull at the New York Hospital confirmed the diagnosis of tuberculosis of cord.

Malignant degeneration of the omentum may take place. This has been observed once at the Hospital for Ruptured and Crippled during the past five years. The extreme hardness of the mass made the diagnosis probable, and it was subsequently confirmed by operation by Dr. Robert F. Weir.[2]

Treatment of Inguinal Hernia.—(*a*) Mechanical; (*b*) Operative.

Mechanical treatment, except in infants and children, must be generally regarded as only palliative. A great variety of trusses are in use, and only a few of the most satisfactory can be described. The principles underlying successful mechanical treatment are the same whatever be the form of the appliance.

Efficiency, or the ability to keep the hernia perfectly reduced, should be the first requisite of a good truss; comfort the second. In most cases a truss can be found that will fulfil both conditions. The pad should be so adjusted that it rests over the *internal* ring, and not upon the pubic bone. The pressure should be sufficient to keep the hernia from entering the canal, and no more, as unnecessary pressure causes atrophy of the muscles and hinders a permanent cure. No form of truss is adapted to all kinds of hernia, but for the great majority of cases of inguinal hernia the "cross-body," or Knight truss, or the Hood truss will be found the most satisfactory.

In the Knight truss the short steel shank is so tempered that it can be bent to the desired angle. In the same way the pressure of the spring itself can be regulated. The size of the pad must be suited to that of the hernial orifice, but skill and experience in adjusting trusses will enable one to control a large hernia with a comparatively small pad. The frame of the Hood truss can be made either of steel, aluminum, or German silver, and various coverings may be employed—*e. g.* rubber, celluloid, or leather. For comfort, leather is by far the best; for cleanliness, hard rubber. Celluloid is good when new, but does not last as well as hard rubber. The pads may be made of polished wood, rubber, or soft material covered with leather. In cases difficult to hold and requiring much pressure the water pad is very satisfactory.

Infants.—No special form of truss is needed in infants and young children. The *worsted*, or so-called "hank truss," has been much praised by some, but the results in a series of 250 infants under one year, observed at the Hospital for Ruptured and Crippled, in which

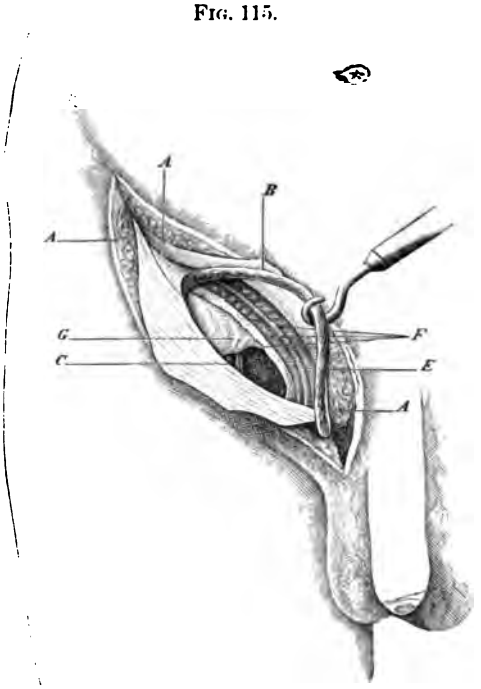
[1] *Hosp. Records*, 1894.
[2] *New York Hospital Records.*

alternate cases were treated with the worsted and the spring truss, proved the latter the superior, and the worsted truss has been discarded.

Results of Mechanical Treatment.—As to the question of cure by means of a truss, Macready says: "We can only speak of probabilities. It may be said that many boys are cured; that the prospect is more favorable still for girls; that the younger the patient the more probable the cure; in those with femoral there is little chance of being able to dispense with a truss; and that after thirty years of age cure is not to be expected in either sex or in either kind of hernia." The London Truss Society's records show that 33 per cent. of ruptured children go beyond the age of eleven years uncured. A few cases have become cured without any treatment. As to the permanence of cure, it is difficult to obtain sufficient data to formulate very definite conclusions. According to Malgaigne, 20 per cent. of the ruptured are cured by a truss.

In hernia complicated with undescended testis a truss should be applied with little reference to the testis. If possible, the pad should rest above the testis. These cases, as a rule, occur in children under

FIG. 115.



Bassini's Method of Operation for Inguinal Hernia.—A, A, A, subcutaneous fatty tissue; *B*, upper portion of the divided aponeurosis dissected from underlying structure; *C*, under portion of aponeurosis of external oblique; *E*, cord; *F*, 1, internal oblique muscle; 2, transversalis; 3, fascia of Cooper.

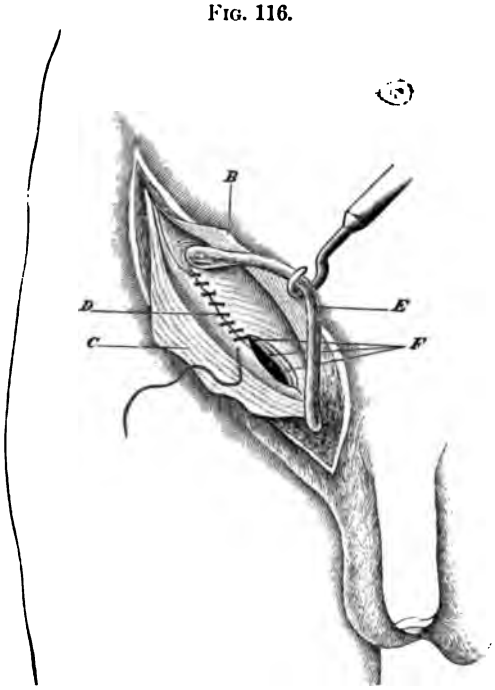
fourteen years of age, and in the majority the testis descends beyond the external ring before puberty. It is seldom necessary to operate for the rupture while the testis is in the canal.

Treatment of Irreducible Hernia.—If the hernia has been irreducible but a short time—*i. e.* a few days—an attempt should be made to

reduce it by taxis. The patient should lie upon his back and the legs may be either straight or flexed. Most surgeons have advised the flexed position, but Macready says that flexing of the thigh is "not only useless, but a positive impediment." The neck of the sac is grasped with the thumb and fingers of one hand, and the fundus of the sac with the other. When both gut and omentum are contained in the sac, the gut usually occupies the posterior portion, and in applying taxis an effort should first be made to reduce the gut.

Pressure may be applied in various ways, but alternate pressure over the neck and fundus, combined with lifting up the fundus, is the most

FIG. 116.



Bassini's Method of Operation for Inguinal Hernia.—The end of the third step of the operation. The cord has been transplanted and the musculo-aponeurotic tissues on the inner side have been sutured to Poupart's ligament (*D*) on the outer side (interrupted sutures are usually employed).

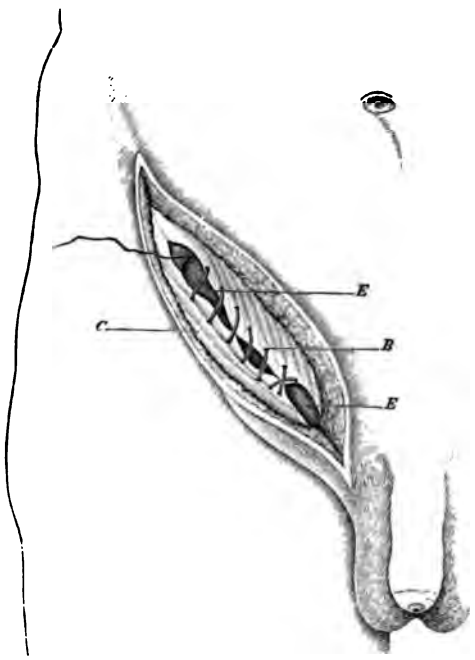
likely to succeed. Taxis should not be used more than five minutes. Greater force may be used than in strangulated hernia. If taxis does not succeed, reduction is often accomplished by rest in bed for a few days.

If the hernia shows some signs of inflammation, the local application of ice is of advantage. If the hernia has been irreducible for a number of months, neither taxis nor rest will be likely to avail. Such cases, if the hernia is not too large, may be treated by means of a truss with a hollow pad. If the hernia is of large size, nothing better can be done than to wear a scrotal bag made of strong material and supported from the shoulders as well as from the pelvis.

Operative Treatment of Inguinal Hernia.—The indications and

contraindications for operation have been given in the section on General Hernia.

FIG. 117.



Bassini's Method of Operation for Inguinal Hernia.—Fourth step. Suture of the divided aponeurosis over the cord with a continuous suture.

METHODS OF OPERATION.

Bassini's Operation.[1]—1. The *external incision* begins at a point nearly or quite on a level with the anterior superior spine, continues obliquely downward parallel to and about half an inch internal to Poupart's ligament, and ends at the centre of the external ring.

2. The incision is rapidly carried down until the aponeurosis of the external oblique is freely exposed for a distance of two and a half to three inches; a director is then passed through the external ring just beneath the aponeurosis, and the aponeurosis is divided well above—*i. e.* one-half to one inch above the internal ring.

3. The cut edges of the aponeurosis are held up with forceps and dissected free from the underlying muscles as far as the edge of the rectus internally and externally until the shelving portion of Poupart's ligament has been clearly exposed.

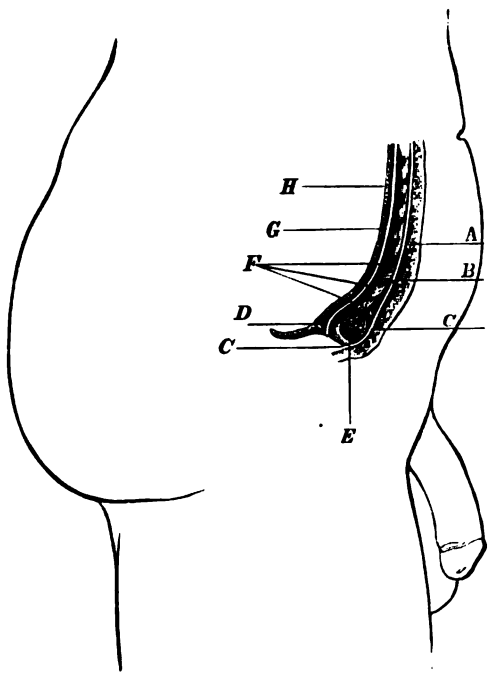
4. The sac and cord are then isolated *en masse*, and this is best accomplished with the fingers and blunt-pointed curved scissors. If the peritoneal layer of the sac is first reached, the dissection is easy, rapid, and bloodless.

5. The cord and its vessels are now separated from the sac, and this, too, is best done with the fingers. The separation is carried high up

[1] "Ueber die Behandlung des Leistenbruches," von Ed. Bassini, *Archiv f. klin. Chir.*, Bd. 40, 429, 1890.

rnal oblique and transversalis muscles, the transversalis fascia (and

FIG. 118.



Bassini's Method of Operation for Inguinal Hernia.—*A*, entire thickness of wall; *B*, aponeurosis; *C*, Poupart's ligament; *D*, Poupart's ligament, under portion; *E*, cord.

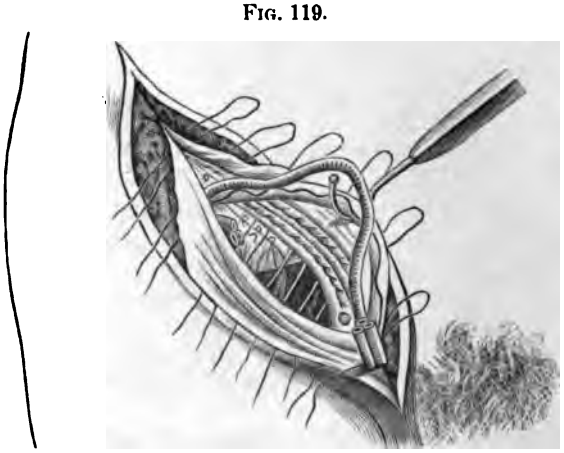
sometimes the edge of the rectus) on the inner side, and the deep shelving portion of Poupart's ligament on the outer side. The lowermost sure should embrace the conjoined tendon.

7. The cord is now replaced, and the cut aponeurosis is closed over it by means of a continuous suture extending as near the pubis as possible without causing undue constriction of the cord.

8. Closing the skin wound with interrupted sutures without drainage.

port of my operation. Instead of trying to repair the old canal and the internal abdominal ring, as Macewen had tried to do, I make a new canal and a new ring. The latter should fit the cord as snugly as possible, and the cord should be as small as possible. The skin incision extends from a point about five centimetres above and external to the internal abdominal ring to the spine of the pubes. The subcutaneous tissues are divided so as to expose clearly the aponeurosis of the external oblique muscle and the external abdominal ring. The aponeurosis of the external oblique muscle, the internal oblique and transversalis muscles, and the transversalis fascia are cut through from the external abdominal ring to a point about two centimetres above and external to the internal abdominal ring. The vas deferens and the blood-vessels of the cord are isolated. All but one or two of the veins of the cord are excised. The sac is carefully isolated and opened and its contents replaced. A piece of gauze is usually employed to replace and retain the intestines. With the division of the abdominal muscles and the transversalis fascia the so-called neck of the sac vanishes. There is no longer a constriction of the sac. The communication between the sac and the abdominal cavity is sometimes large enough to admit one's hand. The sac having been completely isolated and its contents replaced, the peritoneal cavity is closed by a few fine silk mattress-sutures, sometimes by a continuous suture. The sac is cut away close to the sutures. The cord in its reduced form is raised on a hook out of the wound to facilitate the introduction of the six or eight deep mattress-sutures, which pass through the aponeurosis of the external oblique, and through the internal oblique and transversalis muscles and transversalis fascia on the one side, and through the transversalis fascia and Poupart's ligament and fibres of the aponeurosis of the external oblique muscle on the other. The two outermost of these deep mattress-sutures pass

FIG. 119.



Halsted's Operation for Inguinal Hernia.—First step.

through muscular tissues and the same tissues on both sides of the wound. They are the most important stitches, for the transplanted cord passes out between them. If placed too close together, the circulation

of the cord might be imperilled, and if too far apart the hernia might recur. They should, however, be near enough to each other to grip the cord. The precise point out to which the cord is transplanted depends upon the condition of the muscles at the internal abdominal ring. If

FIG. 120.

Halsted's Operation for Inguinal Hernia.—Second step.

in this situation they are thick and firm and present broad, raw surfaces, the cord may be brought out here. But if the muscles are attenuated at this point and present thin, cut edges, the cord is transplanted farther out. The skin-wound is brought together by buried skin sutures of

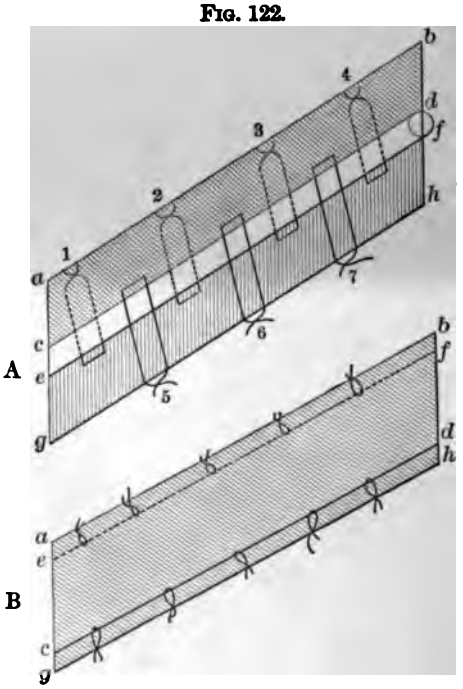
FIG. 121.

Halsted's Operation for Inguinal Hernia.—Third step. Steps of operation for inguinal hernia.

very fine silk. Instead of the interrupted buried skin suture, as shown in Figs. 119, 120, 121, we now use an uninterrupted buried skin suture without knots, which is withdrawn after two or three weeks. The transplanted cord lies on the aponeurosis of the external oblique muscle, and is covered by skin only.

Method of Lucas Championnière.—Championnière deserves great credit as a pioneer in the modern operative treatment of hernia, and his work has done much toward establishing the *radical cure* of hernia upon a scientific basis. He has operated upon 486 cases[1] by a method devised by himself. The mortality has been less than 1 per cent. (4 deaths in 486 cases). The relapses in the cases traced amount to less than 10 per cent., and his oldest case remains cured fifteen years after operation. The method consists—(1) in an incision very similar to that employed in Bassini's operation, being about three inches in length, parallel to, and one-half an inch interior to, Poupart's ligament. (2) The sac is dissected free from the cord and ligated high up, well beyond the neck. (3) The cord is left undisturbed, and the canal is closed by placing a series of mattress-sutures in such a manner that the muscles forming the inner portion of the canal are made to *overlap* the *outer* portion. By regulating the tension of these "flaps" the canal can be firmly closed to the desired extent. A diagram will best explain the position

FIG. 122.



and action of the sutures. In the diagram (Fig. 122) *a*, *b*, *c*, *d* mark the inner muscular and aponeurotic flap; *e*, *f*, *g*, *h*, the outer aponeurotic flap; 1, 2, 3, 4 are sutures first inserted near the edge of the outer flap. The ends of these sutures are then passed well under the inner flap—*i. e.* one-half to three-fourths of an inch from the edge. When all have been inserted they are tied. This brings the edge, *e*, *f*, of the outer flap into the position *e*, *f*, as seen in Fig. B. The edge, *c*, *d*, of inner flap is then brought down by means of similar sutures, and fastened

[1] Personal communication.

to the external portion of Poupart's ligament, as shown in *c*, *d*, Fig. B. The sutures employed by Championnière in all of his cases have been catgut, large size, and prepared according to Lister's original method (carbolized oil). The wound is closed without drainage, and the patient kept in bed about three weeks.

Kocher's Method.—The original feature of this method is the treatment of the sac. Instead of slitting up the aponeurosis of the external oblique muscle, as is done in Bassini's operation, a small incision is made through the aponeurosis over the internal ring, the finger being in the canal as a guide. A pair of artery forceps is then pressed through this slit and brought out at the external ring. With the forceps the sac, which has been previously isolated, is drawn upward and brought out through the slit referred to. The sac is then twisted as in Ball's operation, and drawn down so as to lie in a furrow outside the aponeurosis and in the direction of the inguinal canal. In this position from five to seven sutures are passed "through the oblique fibres of the aponeurosis, external oblique muscle, and the underlying muscle-fibres of the external oblique and transversalis, through the hernial sac itself, and including the ligament of Poupart beneath it. These sutures bring together also the pillars of the anterior ring, to which the lower end of the sac is fastened. In case of a long sac all that extends below the external ring is cut away." Kocher, like Bassini, does not advise a truss after operation; Championnière and Macewen do advise it.

Macewen's Method.—The external incision is made much lower down than in Bassini's operation. The distinctive features of Macewen's method are—first, the manner of dealing with the sac; second, the method of closing the canal. The sac is isolated and then transfixed in such a way that tension on the end of the suture draws it into a series of folds, the object being to form a pad or tampon at the internal ring by passing the suture through the abdominal muscles forming the inner portion of the canal. The canal itself is closed by means of heavy catgut sutures (chromicized) so placed as to unite the posterior wall of the canal with Poupart's ligament.

McBurney's Operation.—This operation was extensively adopted by American surgeons in 1889 and 1890, but in consequence of the number of relapses and the better results obtained from Bassini's operation it has been almost if not entirely given up. The technique is simple, and the principal feature of the operation is *healing by granulation*. An incision is made parallel with Poupart's ligament directly over the inguinal canal. The sac is freed and ligated very high up. The skin-edges are fastened by tension sutures to the muscular layers on either side, and the wound is tamponed with iodoform gauze arranged in wedge shape and extending down to the peritoneum. The wound is then allowed to heal from the bottom by granulation, the theory being that the plug of scar-tissue thus formed should make an effectual barrier to the descent of the hernia. The weak point in the operation is that the theory rests on a false assumption. Scar-tissue when subject to constant pressure invariably stretches and yields, and the results of the large number of operations by this method have been in accord with this principle. The length of time required in the healing process—viz. six weeks in bed—is another serious objection to the operation. A far more serious objec-

tion is found in the condition following relapse. The scar-tissue has often become so thin that no form of support can be applied without abrasions and pain (Fig. 123).

FIG. 123.

Relapse following McBurney's operation.

The *Czerny*[1]*-Risel*[2] *method* consists, in addition to the high ligation of the sac, in the suture of the anterior pillars of the external ring. This method was at one time extensively employed, but relapses followed in about 40 to 50 per cent. of the cases.

Socin's method is simple ligation of the sac, without suture of canal.

Ball's method consists in twisting the sac, and then suturing it in the canal. The redundant lower portion is removed.

EXCEPTIONAL FORMS OF INGUINAL HERNIA.

These owe their significance to (*a*) peculiarities in the sac, as in properitoneal hernia, or to (*b*) the nature of the contents.

PROPERITONEAL HERNIA.—Various terms have been employed to designate this comparatively rare form of inguinal hernia. Among these "interstitial" is perhaps the most often seen and the most appropriate.

Varieties.—There are three distinct kinds of *interstitial hernia*, classified according to the relative position of the hernial sac:

(*a*) Where the sac is found between the peritoneum and the transversalis fascia; this is the rarest form. A tumor is seldom present, and the condition is not usually recognized until strangulation has occurred, the only evidences of which are the symptoms of intestinal obstruction. This class of cases has been carefully studied by Krönlein,[3] and the most of our knowledge is due to his investigations. He was able to collect but 25 cases.

[1] *Wiener med. Wochensch.*, 1877. [2] *Deutsche med. Wochensch.*, 1877.
[3] *Archiv f. klin. Chir.*, 1876, xix. 408; 1880, xxv. 548; 1881, xxvi. 521.

(*b*) Where the sac is found between the internal and external oblique muscles.

(*c*) Where the sac is external to the aponeurosis of the external oblique muscles. In the last two forms there is usually present a dis-

FIG. 124.

Properitoneal hernia, with large inguinal tumor (New York Hospital) (Bull).

tinct tumor in the inguinal region. This tumor seldom extends into the scrotum, although in all three varieties a *portion of the sac may protrude into the scrotum*. The tumor often extends well up toward the anterior superior spine, and is generally irreducible, wholly or in part.

FIG. 125.

Properitoneal hernia (New York Hospital) (Bull).

Etiology.—The mode of formation is in many cases difficult of explanation, particularly as regards the rarer form, properitoneal proper,

where the pouch is between the peritoneum and transversalis fascia. In

FIG. 126.

Large properitoneal hernia in female, occupying inguinal (chiefly) and labial region, and containing omentum and much fluid (New York Hospital) (Bull).

these cases it may be due to a displaced internal ring (Meinhard Schmidt[1]) or to an embryonic process of peritoneum.

FIG. 127.

Properitoneal hernia with small inguinal swelling (New York Hospital) (Bull).

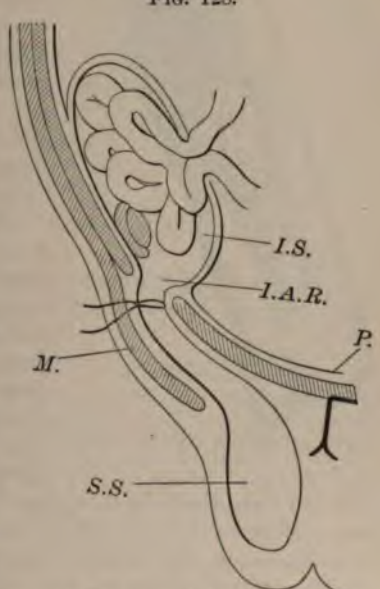
The more common varieties of interstitial hernia admit of a more satisfactory explanation. In the majority of these cases the cause is

[1] *Archiv f. klin. Chir.*, 1885, xxii. 898.

undoubtedly a purely mechanical one. There is nearly always found associated with the hernia either a descended testis or a hydrocele of the canal of Nuck in the female. Either of these conditions prevents the hernia from enlarging in the usual direction—viz. into the scrotum or labium—and, the intra-abdominal pressure remaining constant, the hernial sac continues to enlarge in the line of least resistance. This may be between the two muscles or external to both or internal to both. The omentum is very prone to become adherent in these cases, hence the cause of their frequent irreducibility.

Diagnosis.—This is not difficult if one remembers the possibility of meeting with this form of hernia and is familiar with the main physical signs, which are, as a rule, quite characteristic. Given a tumor in the inguinal region (more probably on the right side), not extending into the scrotum or forming only a small protrusion there, irreducible wholly or in part, having the characteristic feel of omentum or of bowel, and associated either with an undescended or partially descended testis on the same side, or, in the female, with a hydrocele of the canal of Nuck or round ligament, the diagnosis of interstitial hernia is reasonably clear. Several forms of this hernia are illustrated by Figs. 124, 125, 126, 127. A cold abscess from spinal or pelvic-bone disease may closely simulate this form of hernia, and if doubt exists a careful examination of the spine and pelvis should be made. Coley has recently operated upon a case of typical interstitial hernia in which two surgeons, on different occasions, had plunged a good-sized trocar into the tumor, mistaking the condition for one of hydrocele. It is probable that some cases recorded by older surgeons as "*reduction en masse*" or "apparent reduction" have been really cases of this form of hernia. The writers have seen two such within a year. In both instances the hernial tumor occupied both the scrotal and to a less distinct degree the inguinal region. Symptoms of strangulation being present, taxis was made; the scrotal tumor disappeared, and reduction was thought to be complete. The symptoms recurred, an incision was made, and the bowel, still strangulated, was found in the inguinal part of the sac. Both ended fatally.

FIG. 128.



Strangulated inguinal hernia: G. Heaton. *I.S*, intraparietal sac; *I.A.R*, internal abdominal ring; *P*, peritoneum; *M*, muscle; *S.S*, scrotal sac.

Treatment.—The only form of treatment to be recommended is operative. In most cases the testis will be found so near the external ring that it can be brought outside, and the canal may be closed as in the ordinary cases of inguinal hernia, preferably by Bassini's method. If the testis be near the internal ring and greatly atrophied, it may be

removed, as the probability will be that it has no functional value. In strangulated hernia the possibility of encountering one of these unusual forms of sac must be borne in mind, especially when the testis is undescended. The accompanying diagram, from the *Lancet*, Jan. 27, 1894, illustrates a case reported by Dr. Heaton, in which herniotomy was done and the gut reduced into the upper or inguinal part of the sac, and only the lower or scrotal portion tied off. The autopsy revealed the coil of intestine still strangulated in the upper sac (Fig. 128).

Cæcal Hernia.—This form of hernia is far more frequent than might be supposed from the little attention given it in text-books on surgery: in two of the most recent text-books it is not even mentioned. Just how often it occurs can only be roughly estimated by a study of the cases operated upon for radical cure. In a recently published series[1] of 200 operations the cæcum was found in the hernial sac 8 times. In the same series of cases hernia of the sigmoid flexure was observed but once. At the Hospital for Ruptured and Crippled many cases of cæcal and appendical hernia have been observed in infants and young children (under two years of age), although in the majority of cases not confirmed by operation; the appendix could be perfectly outlined, and was so characteristic that the diagnosis was clear. In a number of these cases the cæcum could be reduced, but the appendix could not be on account of adhesions to the sac. In two such cases this condition was shown to exist by operation (Fig. 129).

Fig. 129.

Appendix adherent at tip to bottom of sac.

Etiology. — Cæcal hernia, like other forms of inguinal hernia, may be either congenital or acquired. The majority of cases, especially in young subjects, are congenital. To fully appreciate the causes of cæcal hernia and the true character of the sac one must understand not only the anatomy of the parts, but also the development in fœtal life. Macready states that, "like infantile hernia, congenital hernia of the cæcum differs from others in this, that it appears to depend not, as so many do, on a defect of development, but rather on an excess in that direction." In some cases the smooth muscular fibres of the gubernaculum testis, which extend as far as the parietal peritoneum in the region of the cæcum and sigmoid flexure, are abnormally developed, and may have some influence in dragging down the cæcum in the track of the testis. This theory has been advanced with some force by Wrisberg.

Nature of the Sac.—Until comparatively recently it was believed

[1] Coley, *Annals of Surgery*, April, 1895.

that cæcal hernia frequently had no peritoneal sac, and even at the present day the error is not entirely eradicated. The work of Bardeleben[1] (1849) on the position of the cæcum in man had much to do with establishing the true nature of the sac. His opinion, based on a careful examination of the cæcum in 160 cases, was that "the cæcum is never placed outside the peritoneum in the way described, and cæcal hernia always possesses a peritoneal sac." These conclusions have been recently verified by Treves and others who have made extensive investigation upon the cæcum in connection with the study of appendicitis. In spite of these opinions there remain a *very few* undoubted cases[2] where the cæcum has been found in the hernial sac devoid of peritoneum, or, more correctly speaking, behind the sac (Fig. 130). Cæcal hernia occurs usually in the right side, but may be found on the left. Macready collected 51 cases—36 right inguinal; 9 left inguinal; 5 right femoral; 1 left femoral.

FIG. 130.

Diagram of cæcal hernia (Roser).

Treatment. — This does not differ from that of any other form of hernia. As a matter of fact, the diagnosis is not usually made until the operation, which has probably been advised on account of the difficulty in controlling the rupture, these cases being, as a rule, not easily held by a truss. The sac is usually voluminous, and may better be sutured than ligated. If the appendix is adherent to the sac and the adhesions easily separated, the best plan is to return it to the abdomen. If very adherent, it can be removed at its base and the stump treated as in the ordinary operation for appendicitis. The appendix alone may occupy the hernial sac, and in a few such cases strangulation has occurred.

HERNIA OF THE BLADDER.—Though comparatively rare, this form of hernia deserves special attention for the reason that in most of the recorded cases the bladder was not recognized by the surgeon until it had been cut into. Hernia of the bladder was known to the surgeons of the last century, and Verdier in 1769 published a very valuable monograph upon the subject. Since then, from time to time, the recorded cases have been collected, until at the present time 60 have been found. This number includes 8 cases which have occurred in the practice of leading surgeons of New York, and have been embodied in the most recent and complete paper on this subject, by B. Farquhar Curtis.[3]

[1] *Archiv f. Path. Anat. u. Phys.*, Virchow, 1849, ii. 583.

[2] *Berlin. klin. Woch.*, 1881, Jan. 24, p. 47; Tuffier, *Archiv. gén. de Méd.*, 7 ser., vol. xx. p. 59, 1887.

[3] *Annals of Surgery*, June, 1895.

Anatomically, there are three distinct varieties of hernia of the bladder:

1. Where that portion of the bladder not covered with peritoneum prolapses into the hernial canal. This may be designated the extraperitoneal variety, and it is by far the most common form.

2. The intraperitoneal form, where only that portion of the bladder covered with peritoneum is involved; this is the rarest of the three varieties, only 4 cases having been reported.

3. The third variety is a combination of the two forms just described, the extra- and intraperitoneal portion of the bladder, both forming a part of the hernia: 13 cases out of a total of 55 cases were of this form.

It is easy to see that the first or most common form is the most liable to accidents in the course of a hernia operation, for the reason that there is no true hernial sac and the bladder is opened by mistake for the sac.

The intraperitoneal variety ought to be recognized before injury to the bladder has occurred. Of the 55 cases collected by Curtis, 10 were femoral and 45 inguinal, or a much larger proportion than would be expected when we reflect that inguinal hernia is about eleven times more frequent than femoral. About one-half of the 55 cases were operated upon for strangulation, and this fact may help to explain the large number of the femoral variety, for the reason that strangulation is more likely to occur in this form. An analysis of Ané's[1] collection of 60 cases of hernia of the bladder shows but 3 examples of femoral hernia; 43 cases were inguinal (13 on left side, 10 on the right, 3 on both sides, 17 not noted); 8 cases were perineal; 2 obturator; 2 hernia in the linea alba; and 1 ischiatic.

Etiology.—The supposed causes of bladder hernia are—(*a*) the traction caused by an abnormal development of extraperitoneal fat in the vicinity of the bladder (of doubtful importance); (*b*) The traction of a hernial sac as it is being pushed farther and farther down the canal as the hernia enlarges. A number of cases, as Curtis has pointed out, have been cases of recurrent hernia following operation, and he is inclined to attribute some causal relation to the high ligation of the sac, and consequent traction on the bladder as the new hernial sac is formed.

Diagnosis.—This is seldom possible before operation, but there are sometimes present symptoms that might cause one to suspect the presence of the bladder in the hernia. These symptoms are—difficulty in voiding urine, inability completely to empty the bladder, and frequent attacks of vesical tenesmus, and occasionally retention. Such symptoms, associated with a hernia somewhat resembling to the touch an omental hernia or a thick-walled sac, and perhaps giving the sensation of fluid in the sac, would lead one to think of the possibility of having to deal with a hernia of the bladder. The diagnosis will, as a rule, have to be made during the operation, and there are some points that need to be emphasized. The most constant sign is an unusual amount of subperitoneal fat included in a thin sac-like membrane. The bladder-wall may be so thin that no muscular fibres can be detected, and the resemblance to a hernial sac may be exceedingly close. Of 51 cases, the bladder was recognized in 23 cases before injury; in 10 cases it was mistaken for a hernial sac, in 5 for a tumor or cyst. The introduction of a sound or

[1] *Deut. Zeit. f. Chir.*, vol. 35, 370.

puncture with a fine needle and withdrawal of a fluid having the odor of urine will help to settle the diagnosis.

Mortality, as shown by Curtis's tables, was 25 per cent. in the 41 cases in which the bladder was injured. In but 8 cases could it be said that the wounds of the bladder were even indirectly the cause of death. Many of the operations were done before the antiseptic period, and, moreover, many of the herniæ were strangulated.

The bladder when wounded during operation needs no special **treatment** other than that set forth under the subject of wounds of the bladder in general. If the condition of the bladder warrants, immediate suture should be performed, preferably in two or three layers. The suture should not include the mucous membrane.

INGUINO-PERINEAL HERNIA.

This term may be used to describe a very rare form of hernia associated with perineal ectopia. This hernia, although emerging from the external ring of the inguinal canal, does not enter the scrotum, but descends into the perineum. The hernia is almost always of congenital origin, and the testis is found at the bottom of the hernial sac, in the perineum. The scrotum on the affected side will be found empty and poorly developed. If the hernia is large, a new pouch resembling a scrotum is formed of the skin of the thigh and perineum. One case has been observed by Macready in which the hernia descended into the perineum, while the testis remained in the abdominal cavity. Only 22 cases of this variety of hernia have been observed by the London Truss Society, and these have been tabulated by Macready. The testis was found to be of full size in 1 case, very small in 8, and in 10 cases the hernia was in the tunica vaginalis. In 4 cases the testis could be returned into the abdomen along with the hernia.

FIG. 131.

Inguino-perineal hernia: testis in the bottom of perineal pouch, which is quite distinct from scrotum (Hospital for Ruptured and Crippled). (Coley).

Only one case of this form of hernia has been observed at the Hospital for Ruptured and Crippled. This case is typical, and the chief characteristics are well shown by the accompanying illustration (Fig. 131). The patient, aged twenty-two years, had had a hernia since infancy, but had never been treated. The hernia was of the size of a cocoanut, and was associated with a smaller scrotal hernia of the ordinary type on the opposite side. The pouch containing the hernia was entirely separate from the scrotum, and was made up of the skin of the thigh and perineum. The case was treated by operation by Dr. Coley, the pouch and testis removed, and the canal closed by Bassini's method.

FEMORAL HERNIA.

Femoral or crural hernia (Fig. 132) may be defined as a protrusion through the crural canal, the anatomical boundaries of which are Poupart's ligament above and in front, the pubic bone covered by the (pectineus) muscle and the pubic portion of fascia lata below and behind, Gimbernat's ligament, the conjoined tendon, the transversalis fascia internally, and the portion of fascia lata covering the femoral vein externally. In very rare cases the protrusions may appear directly over the femoral

FIG. 132.

Femoral hernia, double.

vessels or even external to the vessels. Such a case has been recently observed at the Hospital for Ruptured and Crippled of New York. This anomalous form of femoral hernia occurred in a child three and a half years old, and the same form of hernia was found upon both sides. The protrusion was the size of a small hen's egg, and the opening was slightly external to the femoral artery.

Sex and Frequency.—Femoral hernia is more common in the female than the male, in about the proportion of 3 to 1. Of 100 persons ruptured, Macready gives the following distribution: Male inguinal, 83.5 per cent.; female inguinal, 8.5 per cent.; male femoral, 2.1 per cent.; female femoral, 5.9 per cent. It will be seen from the above that femoral hernia in the female is less frequent than inguinal, the contrary being the general impression.

Age.—Femoral hernia seldom occurs before the age of puberty. In 2167 cases of hernia occurring in children under fourteen years observed at the Hospital for Ruptured and Crippled during the years 1891 and 1892, there were 8 cases of femoral hernia.

Anatomy.—The steps in the formation of a femoral hernia are as follows: The parietal peritoneum is pushed forward through the crural canal until it meets the cribriform fascia: this it either penetrates or passes beneath, and emerges at length at the saphenous opening. The important anatomical landmarks are, therefore, Poupart's ligament

above, the pubic spine internally, and the femoral vessels externally. Femoral hernia rarely attains great size, the ordinary type being about as large as a hen's egg. In some cases the sac may extend down the thigh until the hernia becomes the size of a child's head. In other cases the line of least resistance is upward, and the hernia overrides Poupart's ligament and may simulate an inguinal hernia. In fact, this latter form of femoral hernia has been by many surgical writers regarded as the common type. Macready's experience, as well as personal observation at the Hospital for Ruptured and Crippled, proves this to be incorrect.

Coverings.—Beginning externally, the coverings of a femoral hernia are—1. The skin and subcutaneous tissue; 2. The "fascia propria," a term originating with Sir Astley Cooper, and really made up of three distinct structures—viz., septum crurale of Cloquet, the femoral sheath, and the cribriform fascia; 3. The subperitoneal fat and peritoneum.

Contents.—Any of the abdominal viscera that are found in an inguinal hernia may likewise be found in a femoral hernia. Enterocele is less common than in inguinal hernia, and when it occurs the danger of strangulation is much greater than in inguinal. Omentum, either alone or with a portion of intestine, usually forms the contents of the sac. The omentum is very prone to form adhesions in the early stage of the hernia, and this fact accounts for the large number of femoral herniæ that are irreducible.

Physical Signs and Symptoms (*Reducible*).—The early symptoms of femoral hernia are much the same as of inguinal. Pain of a dull aching character is observed in a large number of cases. The pain is less severe and less constant than in inguinal, and it is always aggravated by exertion. Œdema of the leg and numbness have been often looked upon as noteworthy symptoms, but they are so seldom seen that they can be entirely disregarded. The first sign to be observed is, as a rule, a swelling in the region of the femoral ring. This swelling is usually small and globular at first, and increases in size much less rapidly than in inguinal hernia. Many patients give no history.

Diagnosis.—The differential diagnosis between inguinal and femoral hernia has already been given under Inguinal Hernia, yet there are other conditions that may render the diagnosis more or less difficult.

Adenitis.—This is probably the most frequent source of error in the diagnosis of irreducible femoral hernia. The points of difference have been mainly brought out already in inguinal hernia. In adenitis it is almost always possible to detect a more or less lobulated condition of the tumor, owing to its being made of several glands. In rare cases one may find a single gland enlarged to such size as very closely to resemble a femoral hernia, but a careful examination will show that it can be pushed to the one side or the other of the femoral ring, thus proving it does not actually enter the canal.

Psoas Abscess.—This condition should always be kept in mind in the diagnosis of femoral hernia. The diagnosis is best made by the method of examination set forth in reference to inguinal hernia.

Saphenous Varix.—This is a more common source of error than psoas abscess; the tumor is precisely in the situation for a femoral hernia; it resembles it closely in shape, has distinct impulse on coughing, and is reducible under pressure or on lying down. The diagnosis is easy if two

points are carefully observed: first, the character of the impulse; second, the fact that the tumor slowly reappears on standing, even though moderate pressure be applied over the crural opening. It is very important

FIG. 133.

Varix of saphenous vein (Hospital for Ruptured and Crippled).

to note the condition of the veins of the leg and thigh, for the reason that in nearly all cases of saphenous varix these will be found in a varicose state. (See Fig. 133.)

FIG. 134.

Sarcoma of femoral glands.

Carcinoma or *sarcoma* of the femoral glands may be mistaken for an irreducible femoral hernia. (See Fig. 134.) This condition is rare, and is usually secondary to malignant disease elsewhere—*e. g.* in the foot,

leg, vulva, or rectum; and hence a careful examination of all these regions is important in determining the diagnosis.

True *lipomata* may occur in the region of a femoral hernia, and in such cases the diagnosis may be very difficult. The principal point of difference is the greater mobility in lipoma than in hernia.

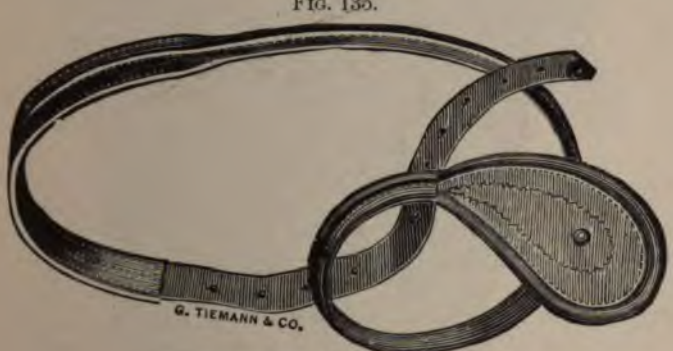
Hypertrophy of the extraperitoneal fat in the region of the crural opening often closely simulates a femoral hernia. The history of the case will show that the swelling was of slow growth and irreducible from the beginning.

Cysts may occur in the femoral canal. They are very rare, and the diagnosis is not possible without operation. In rare instances the neck of the sac may become obliterated by adhesions, and an accumulation of fluid (hydrocele of the hernial sac) may occur in the sac itself. One such case was operated upon at the New York Hospital.[1] More frequently a bit of adherent omentum at the neck of the sac shuts off the communication with the abdomen. Cases of this kind have been observed in which three or four pints of fluid were found in the otherwise empty sac.[2]

Prognosis.—The majority of femoral herniæ can be controlled by a well-fitting truss, but permanent cure is rarely if ever attained. Femoral hernia is more liable to become irreducible than inguinal; strangulation is also relatively more frequent.

Treatment (Mechanical).—*Form of Truss.*—The cross-body or Knight truss can be used for femoral as well as inguinal hernia. If the hernia is small and easily held in place, the French truss (see Fig. 135)

FIG. 135.



French adjustable truss. Soft pad, right.

can be worn with greater comfort. If the hernia is irreducible and of small volume, it may be kept from getting larger by wearing a truss with a concave pad.

If recently irreducible, taxis should be tried. Taxis is less successful in femoral than in inguinal hernia. In applying taxis one should bear in mind the fact that the axes of the fundus of the sac are often at right angles to those of the neck, and in order to reduce the rupture these axes must be brought as nearly as possible into line. This can be

[1] *New York Hosp. Records*, 1891.
[2] *St. Bartholomew's Hosp. Reports*, 1875, x. 381.

done by pressing downward upon the fundus with the right hand, using the left to manipulate the neck of the sac and to prevent the portion of hernia reduced from reappearing in the sec. Taxis should not be used more than five minutes.

The application of a soft pad of cotton or gauze, held in place by a firm spica and renewed every three or four days, will occasionally bring about reduction in cases of epiplocele, and specially devised trusses with concave pads may produce the same results; but success depends upon the exercise of patience, as shown by Macready's[1] tables. Of 67 cases of femoral hernia treated with a hollow pad, 18 were reduced on an average of seventy-five days, and 49 were reduced on an average of 3.9 years.

Treatment.—In subjects under forty years of age with reducible femoral hernia, and in the absence of contraindications, operation

FIG. 136.

Bassini's Operation for Femoral Hernia.—Hernial orifice and canal.

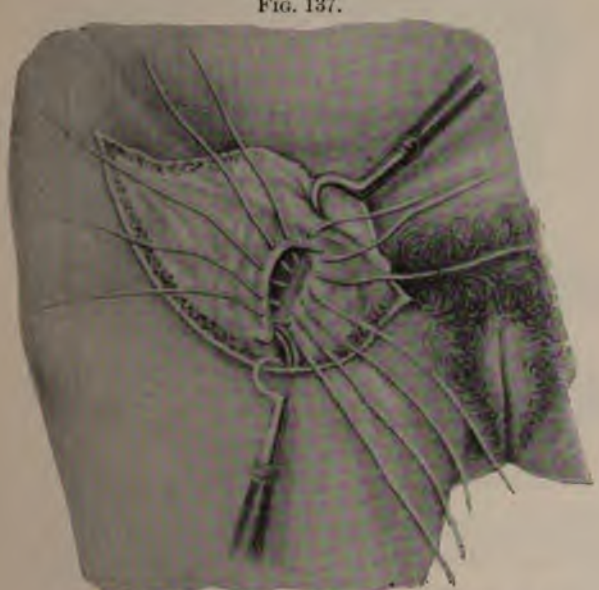
should be recommended. The mortality in such cases should be practically *nil*, and the final results are better than those following operation for inguinal hernia. If the hernia is irreducible, the indications for operation are even stronger. The contraindications have already been enumerated in the part relating to Hernia in general. The operation to

[1] *Loc. cit.*, p. 220.

be advised is high ligation of the sac after careful dissection from the crural canal, and closure of the canal itself by means of buried sutures, preferably of kangaroo tendon. The closure of the canal may be accomplished by two methods: 1. By means of a purse-string suture encircling the opening, and which when tied brings the floor of the canal up against Poupart's ligament. 2. Bassini has devised an operation for femoral hernia which in his hands has yielded perfect results.

Bassini's[1] *Operation for Femoral Hernia* (Figs. 136, 137, 138).—The incision is made parallel with Poupart's ligament and over the centre of the tumor. The sac is dissected free from the canal and ligated as high up as possible. With a curved needle these silk sutures are inserted so as to unite Poupart's ligament with the pectineal fascia, the first being

FIG. 137.



Bassini's Operation for Femoral Hernia.—Sutures in place.

placed near the spine of the pubis, the second one half a centimetre externally, and the third one centimetre from the femoral vein. These sutures are left untied until three or four others have been passed—first through the edge of the falciform fascia, then the pectineal fascia, the lower suture entering just above the saphenous vein. The upper sutures, which draw Poupart's ligament backward to the pectineal line, are then fastened. The other sutures, which bring together the anterior and posterior walls of the canal, are next tied, and lastly the skin-incision is closed without drainage. The accompanying illustrations show the different steps of the operation.

Bassini has operated upon 54 cases by this method, with no deaths and without a single relapse in 41 cases traced from two to nine years after operation.

[1] *Archiv für klin. Chirug.*, 1894, vol. xlvii. p. 1.

Cushing and Marcy have practised a method of closing the canal with a "purse-string" suture, which accomplishes the same purpose as Bassini's method, but is more complicated in its execution.

In herniotomy for strangulated femoral hernia it is a matter of indifference whether the incision be vertical or parallel with Poupart's liga-

FIG. 138.

Bassini's Operation for Femoral Hernia.—Sutures tied.

ment. It is essential, however, clearly to expose Poupart's ligament as a first landmark. After opening the sac, which is not infrequently covered with a surprisingly thick layer of subperitoneal fat, the constriction at the neck (Gimbernat's ligament) should be divided by a series of slight nicks in an upward and inward direction.

In most cases it will be feasible and judicious to attempt a radical cure by ligating the sac at the highest point and excising it. It would seem proper, however, except in a very recent case, to abstain from applying sutures to close the canal itself because of the risk of shutting in infectious material derived from the sac and its contents. For the same reason it is better to use an iodoform-gauze drain in closing the wound.

UMBILICAL HERNIA.

Like inguinal hernia, umbilical hernia may be either congenital or acquired. True congenital umbilical hernia develops before the falling of the cord, but the term is generally used to include as well the hernia that develops in early infancy. The term "congenital hernia of the cord" is sometimes used to distinguish the first variety from the second.

The cause of this form of hernia is to be found in defective develop-

ment during fœtal life. It is very rare, and but two cases have been observed at the Hospital for Ruptured and Crippled during a period of five years. Lindfors estimates its frequency at 1 in 5184 children.[1]

FIG. 139.

Umbilical bandage.

FIG. 140.

Elastic belt.

In size the hernia may vary greatly from a simple bulging at the base of the cord, often designated as "hernia of the root of the cord," to a complete eventration, in which the sac may contain the liver, stomach, and spleen in addition to the intestines.

FIG. 141.

Elastic umbilical truss, with transparent celluloid pad.

There is no true sac in this form of hernia. The protruding viscera are coated with the myxomatous tissues of the cord and covered by its amniotic layer, which is continuous with the skin and the peritoneum.

Prognosis.—There is danger to life from peritonitis, which may be fatal within several days.[2]

Treatment.—The treatment of this variety of umbilical hernia may be either expectant or operative.

Macready, quoting Macdondald's statistics, cites 12 cases treated by compress and bandage, of which 9 died, while of 19 treated by laparotomy only 2 died.[3]

INFANTILE UMBILICAL HERNIA.—This variety is found in both sexes, in about an equal proportion of cases, up to the age of ten years, after which period it is seen more frequently in the female, though rare before the age of twenty years. Taking all ages together, Macready states the proportion of female cases to male as 2.7 to 1.

Mode of Exit and Coverings of Sac.—Umbilical hernia is a direct hernia, and protrudes through the gap in the linea alba once occupied by the cord. The coverings are the peritoneum, the deep fascia, the superficial fascia, and the skin.

[1] Warren, J. C., *Transactions American Surg. Assoc.*, 1892; Scudder, *Boston Med. and Surg. Journ.*, Jan. 4, 1894.

[2] *Centralb. f. Gynäk.*, 1884, p. 255.

[3] Macready, p. 246.

Mode of Onset and Subsequent Course.—The hernia may, in rare instances, appear suddenly, but as in inguinal hernia the onset is usually very gradual and the increase in size slow.

In infancy and youth the tendency is very strong toward spontaneous cure. It is very rare to find an umbilical hernia between the ages of fourteen and twenty years. After that period, owing to childbearing in the female and to severe strains in the male, we find the umbilical hernia of the adult, the course and prognosis of which differ widely from the umbilical hernia of childhood.

Symptoms.—Umbilical herniæ in children are almost always reducible, and seldom give rise to any symptoms worthy of note. Haas[1] claims to have observed irregularity in intestinal functions, diarrhœa, and colic.

Treatment.—Though many umbilical herniæ in children would doubtless be cured without any treatment, nevertheless some form of treatment should in all cases be advised. The great difficulty of keeping any form of truss or even abdominal belt in position in infants and young children has led to the adoption of the following method: A strip of rubber plaster about two inches in width is made to encircle the body on a level with the umbilicus; a small pad, consisting of a wooden button covered with plaster or linen, is placed directly over the hernia, so that when the plaster is in position the hernia will be perfectly reduced. Great care should be exercised not to have the plaster too tight, and it should not be allowed to remain longer than ten days without renewal. Cases treated in this way are usually cured within a few months, and treatment is seldom needed beyond one year.

In older children and in adults some form of abdominal belt, with a pad of varying size and thickness according to the conditions present, may be recommended.

Operative Treatment.—The prognosis is so good from mechanical treatment that operation should very rarely be resorted to. The hernia is almost always reducible, and seldom becomes strangulated. Should a child reach the age of puberty with an umbilical hernia that had existed since infancy without improvement from careful mechanical treatment, operation would be justifiable. If done under favorable conditions, there should be very little risk.

The operation to be recommended is excision of the umbilicus (omphalectomy) and careful suture in separate layers, the buried sutures being of a non-absorbable material and of such nature that they will resist absorption for a sufficient time to permit firm union.

The number of cases of umbilical hernia in children treated by operation is too small to make it possible to speak of final results.

Umbilical Hernia in Adults.—Here we have to deal with pathological conditions very different from those present in infantile hernia.

The exact site of umbilical hernia, or the point where the sac is forced through the abdominal wall, has been the subject of much dispute. Petit held that this point was not in the umbilicus proper, but alongside of it. This opinion was later disproved by Astley Cooper, Malgaigne, and others, and it is now accepted as beyond question that the great majority of umbilical herniæ come directly through the umbilical

[1] Poulet Bousquet, *Pathologie externe*, vol. iii., p. 132.

ring. There are, however, certain rare cases in which the opening is clearly outside of the ring proper, and these have been sometimes characterized as "para-umbilical" hernia. They are, strictly speaking, only a variety of ventral hernia.

Not only does the umbilical hernia emerge from the umbilical ring, but it nearly always is found in the upper portion of this ring. The anatomical reasons for this lie in the fact that the umbilical vein usually occupies this position, while the artery is found below. As the process of cicatrization goes on the denser tissues of the artery form a stronger barrier than those of the vein.

The *coverings* consist of the skin, subcutaneous tissue, and peritoneum. The *contents* of the sac are either the omentum alone or the omentum with the transverse colon or the small intestine. Occasionally the omentum is spread out as a thin layer lining the inner surface of the sac. Adhesions are prone to form at an early period, which, according to their extent, make the rupture wholly or partly irreducible. Intestine alone is seldom found.

Etiology.—Severe strains, childbearing, ascites—in fact, anything that greatly increases the intra-abdominal pressure—may be classed as active causes in the production of umbilical hernia, while obesity, and consequent atrophy of abdominal muscles, as passive causes, play a no less important rôle.

Symptoms.—The symptoms differ little from those seen in inguinal hernia, although it has been stated, and is probably true, that digestive disturbances are more common in umbilical.

Diagnosis.—This is seldom difficult, and one can usually determine with ease the contents of the hernia according to the principles already laid down for the diagnosis of inguinal and femoral hernia.

Prognosis.—This must be looked upon from two points of view—first, as regards cure, and second, as regards danger to life. Spontaneous cure, so common in childhood, is probably never seen in adults, nor is much to be hoped for in the way of cure by means of mechanical support.

Treatment.—The best result to be expected from palliative measures is to keep the hernia from becoming larger, and, what is of far greater importance, from becoming irreducible. The strong tendency of these herniæ is to become irreducible and adherent, in spite of careful treatment.

The best form of support is a well-made abdominal belt, with a circular pad of size and thickness to correspond to the size of the opening and to the thickness of the abdominal wall. In very obese subjects the pad must be made thick, so that when the belt is in place the pad keeps the hernia reduced (Fig. 141).

Operative Treatment—At present it is impossible to lay down any definite rules as to how far radical-cure methods should be applied to reducible umbilical hernia in adults. No very large number of cases has been operated upon by a single surgeon, and the results have not been followed for a sufficient time to enable one to judge of the permanence of the cure. In this class of cases the mortality ought to be very slight, and if the operation could be shown to produce permanent cure in the larger proportion of cases, there would be strong reasons for recommending it. The period of reducibility is manifestly the one dur-

ing which the operation should be undertaken, if at all, for the reasons that during this period the patient is younger, the abdomen is smaller, and, moreover, the dangers attending the ligation of large masses of omentum and the separation of old adhesions are not present.

A careful review of the cases thus far subjected to operation leads to the conclusion that the proportion of relapses following operation for umbilical hernia is much greater than that following inguinal and femoral hernia. The large number of ventral hernias following simple laparotomy wounds, even in the hands of skilful surgeons, is evidence that it will be difficult to attain perfect success in the operative treatment of umbilical hernia.

The best method of operation is to remove by an elliptical incision the umbilicus and superfluous portion of skin and sac. The peritoneum should then be closed separately, if possible, by a continuous suture of catgut. If this cannot be done, the two layers of the peritoneum and fascia transversalis may be sutured with interrupted sutures of kangaroo tendon or chromicized catgut. Over this the skin may be sutured with catgut, silk, or silkworm gut.

Gersuny[1] has described a new operation for umbilical hernia, or rather has applied his method of closing an abdominal wound to the treatment of umbilical hernia. The skin and sac are resected and the cut edges of the peritoneum sutured. The sheaths of the recti muscles are then exposed at their inner margins, which are cut away until the innermost muscular fibres are plainly visible. The edges of the recti are then brought together and sutured. The superficial portion is packed with gauze for a few days, and then the sutures placed at time of operation are tied.

Schede[2] uses only silver wire, placed in two rows, the one passing through all the layers of the abdominal wall, and the other (buried) including only the rectus muscles and peritoneum.

FIG. 142.

Umbilical hernia, irreducible, with excoriation of the skin over the sac.

IRREDUCIBLE UMBILICAL HERNIA.—As has already been stated, the natural course of an umbilical hernia in the adult is to become adherent to the sac and irreducible, sooner or later. When this has occurred, the hernia usually increases in size, is often seen as large as a fist, becomes lobulated, and descends toward the pubes.

The symptoms are dragging pain on exertion and inability to do hard work. This condition renders the person liable to attacks of obstruction or local inflammation lasting from two to four days. If not controlled, the tendency is to get larger.

[1] *Brit. Med. Journ.*, Nov. 18, 1893.
[2] *Medical Press and Circular*, June 6, 1894.

The irritation of the bandage or support may excite a more or less active inflammation in the coverings of the hernia, producing ulceration of large areas of skin and local peritonitis within the sac.

Contents.—In the great majority of these cases omentum alone is contained in the sac.

The same pathological changes may take place in the omentum as have been referred to in irreducible inguinal hernia. Not infrequently a portion of the intestines, large or small, is associated with omentum, and in such cases the functional disturbances of the bowels are more prominent and the danger to the patient from strangulation is constantly present. Strangulation, though rarer than in inguinal and femoral hernia, is nevertheless of great importance, inasmuch as it is attended with larger risk to life.

Treatment.—*Palliative.*—This consists of support by means of an abdominal belt, already described, without the pad or with the substitution of a larger pad, very thin and concave. The patient should avoid constipation and use caution in regard to diet. If symptoms of obstruction are present, local application of ice and rest in bed should be advised. If the hernia becomes strangulated, taxis should be tried, and if this be unsuccessful, herniotomy should be performed.

Operative Treatment.—Operation is not to be recommended in this form of hernia, except in special cases, for the following reasons: The subjects are, as a rule, extremely unfavorable for operation; the abdomen is large and pendulous; a thick layer of subcutaneous fat interferes seriously with primary union; the muscular layers are atrophied; more important still, the necessity of ligating large masses of omentum and separating extensive adhesions makes the operation one of decided risk to life. Finally, the operation, if successful, gives but little guarantee of permanent cure. Relapses in such cases are very frequent. On the other hand, small herniæ in persons with firm abdominal walls of moderate thickness may be properly subjected to operation, in the hope that even in the event of relapse the protrusion may be more readily controlled and kept reducible.

VENTRAL HERNIA.

This term is applied to herniæ which emerge at other points in the abdomen than those already enumerated. The hernial orifice usually corresponds with congenital defects in the aponeurotic layer of the parietes, and hence these ruptures are most frequently seen in the median line or the outer side of the rectus muscle, the linea alba, or linea semilunaris. The subjects are, as a rule, in middle life, the protrusions small, painless, reducible, and easy controlled. The contents are usually omentum. Protrusions of masses of subperitoneal fat have been known to come through these gaps in the aponeuroses, and to drag after them a slender cone of peritoneum, the whole constituting a reducible tumor, but (as tested by operation) without "contents." These have been twice observed in the epigastric region by the writers, and been treated by operation. The support of a belt with suitable pad, as in umbilical hernia, is all that is required in most cases. A radical operation may be done, but we have as yet no evidence as to the final results.

Ventral hernia may follow injuries to the abdominal wall. Any wound, accidental or intentional, made through all layers of the abdominal

FIG. 143.

Large ventral hernia following abdominal section in median line, front view (Hospital for Ruptured and Crippled).

wall is likely at some period to be followed by a yielding of the line

FIG. 144.

Large ventral hernia following abdominal section in median line, side view (Hospital for Ruptured and Crippled).

union and a bulging or protrusion of a part of the abdominal contents. Rupture of muscular fibres and the cicatrices following abscesses may

give rise to the same condition. The features of this form of hernia, to which the term "traumatic" is sometimes applied, differ from those of hernia at the anatomical sites in that there is no sharply-outlined orifice

Fig. 145.

Ventral hernia following incision for appendicitis abscess (Hospital for Ruptured and Crippled).

Fig. 146.

Front view of 145.

and often no distinct sac. The scar may yield all along the line of union, making the orifice a longitudinal slit, or give way at either extremity or

Fig. 147.

Abdominal wall after four successive laparotomies: 1, ventral hernia of moderate size requiring support; 2, small hernia in centre of yielding cicatrix; 3, cicatrix still firm after two incisions.

Fig. 148.

Ventral hernia following lacerated wound thirty years after injury (Hospital for Ruptured and Crippled).

in one or two separate places. The viscera are often adherent to the cicatrix, which in large protrusions becomes so thin as to be transparent. If the peritoneum cover the viscera, it is itself fused with the cicatricial

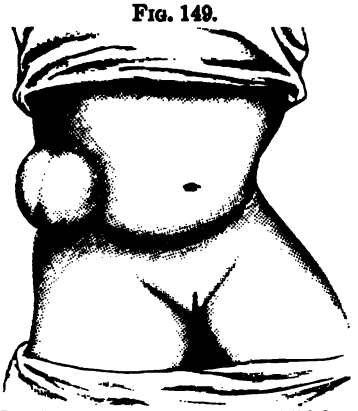
tissue, and often attached by light or firm adhesions to the subjacent omentum or intestine. In ventral hernia following ruptures of the muscle or wounds which have united primarily the skin is usually movable over the serous membrane, and the conditions more closely resemble a true hernia. These protrusions do not increase in size if the abdomen is properly supported, are not liable to become strangulated, irreducible, or obstructed, and give rise to pain and discomfort only upon severe exertion. A well-fitting abdominal belt should be applied so soon as the slightest weakness in any scar is discovered. The radical cure has been frequently attempted by removing the cicatricial parts of the orifice and uniting the layers of the abdominal wall by sutures of different materials. The operation appears to have a trifling mortality, but the permanency of the "cures" is still open to doubt. From March, 1891, to December, 1895, 200 cases of ventral hernia following abdominal operations and injuries were observed at the Hospital for Ruptured and Crippled (Figs. 143–146).

Rare Varieties of Hernia.

LUMBAR HERNIA.

If cases having a distinctly traumatic origin are excluded, very few instances of lumbar hernia are recorded. Most of these appear to have protruded in the triangle of Petit—that is, the space just above the iliac crest and between the latissimus dorsi and external oblique muscles—but in one case certainly the point of exit was just below the twelfth rib. The weakness of this spot is only appreciated after the latissimus dorsi has been turned aside.

Fig. 149.



Lumbar hernia, congenital, in child five years old (operated on at Hospital for Ruptured and Crippled).

Lumbar hernia is controlled by a truss whose fixed point is a pad resting on the opposite hip, between the trochanter and iliac crest. A perineal strap prevents this pad from rising. The operative treatment is similar to that of ventral hernia.

OBTURATOR HERNIA.

Another unusual passage for a hernia is the canal occupied by the obturator vessels and nerve. Its direction is forward, downward, and inward, along the outer portion of the horizontal ramus of the pubis. This groove is converted by the obturator membrane into a canal about two centimetres long and with diameters of one and one and a half centimetres. The sac of an obturator hernia is composed of pelvic peritoneum —possibly the broad ligament—and as the viscus descends it usually carries before it the fascia of the obturator internus muscle. It may emerge under the obturator externus muscle, or, passing over that, lie under the pectineus and adductor longus muscles. It is too deeply situ-

ated to be evident in Scarpa's triangle; hence it has often been overlooked until strangulation has set in. The nerve and artery may occupy any relation to the sac, but they are usually found to the outer side. The next common position for the nerve is in front, and for the artery behind the sac.

Of 63 recorded cases of obturator hernia, only 4 occurred in men, and the average age in 53 cases was 61.3 years.

On account of its concealed location, obturator hernia is easily overlooked until symptoms of strangulation appear. The more usual symptoms are constipation, with occasional attacks of abdominal cramp lasting a few hours. There may be nausea, but seldom vomiting. The hernia is best detected when the thigh is rotated outward, flexed, and adducted. If then the finger is placed along the pubic ramus behind the adductor longus, the tumor may be felt, or it may be sought for with the finger in the vagina or rectum.

One other important symptom is the pain caused by pressure on the obturator nerve. Sometimes both active and passive motion of the thigh is painful. Sometimes anæsthesia is present. But the usual symptom is neuralgia, the pain being described as cutting, burning, or tearing, and referred to the inner side of the thigh from the groin to the knee or below it. This pain has misled skilful surgeons into treating the patient for rheumatism or some other trouble, with fatal result. And, indeed, there are cases of suppurative pelvic inflammation which give rise to symptoms not different from those of obturator neuralgia.

The only **treatment** in the majority of cases is operative. From the deep position of the canal a truss is out of the question. If reduction is attempted, pressure should be applied posterior to the adductor longus muscle, in a direction upward, outward, and backward—that is, in the direction of the canal from without. These herniæ are almost always interstitial, and the death-rate from strangulation is very high: Macready gives it as 84.4 per cent. The hernia may be reached by an incision in Scarpa's triangle. After separation of the pectineus and adductor longus muscles the sac is exposed, or the incision may be made into the abdomen above the pubis. This latter operation gives a much clearer view of the bowel which is involved—a consideration of no small importance when it is remembered that in the cases thus far operated upon the average duration of strangulation was over seven days. The abdominal incision may be in the linea alba or in the lower portion of the linea semilunaris.

DIAPHRAGMATIC HERNIA.

It occasionally happens that a child is born whose diaphragm is incomplete and whose thorax contains some of the abdominal organs. This condition interferes with the action of the heart and lungs to such an extent that life is of short duration.

True diaphragmatic hernia also occurs, though it is very rare. It results from a muscular strain or from external violence. A sac is usually present. The hernia may escape either through one of the normal openings in the diaphragm or through a cleft in the muscle. The sac may contain only a loop of small intestine or part of the colon; but

the greater portion of the large and small intestine, the spleen, pancreas, and a portion of the stomach have all been found in such a hernia.

Unfortunately, the **diagnosis** has thus far, as a rule, been made on the autopsy table. Some of the cases would have been amenable to treatment had the state of affairs been recognized during life. Of the 250 cases in Leichtenstern's collection, in but 5 was the diagnosis made before death.

ISCHIATIC HERNIA.

A very few cases are on record where some viscus has left the abdomen by the great sacro-sciatic notch. Such herniæ may contain the omentum, intestine, ovary, or part of the bladder. If the hernia reaches a considerable size, it may pass below the gluteus and down the thigh, or forward above the great trochanter toward the groin. It must be distinguished from lipoma, cyst, hæmatoma, abscess, and aneurysm of the gluteal or ischiatic arteries, and in infants from spina bifida. On account of the constantly changing shape of the buttock a truss would be difficult to apply. Incision for the relief of strangulation or the cure of the hernia might be made directly upon the sac or a median laparotomy may be performed.

PELVIC HERNIA (PUDENDAL, PERINEAL, RECTAL).

Hernia may be present in several situations in the pelvic floor—in the ischio-rectal space, the perineum, the vagina, or the labium majus. As our knowledge of the starting-point of such herniæ is very imperfect, it has been customary to designate them by the name of the region in which they appear.

In spite of its apparent weakness, a hernia through the pelvic floor is a rare occurrence. Various reasons for this have been assigned. The firmness of the pelvic fascia, the obliquity of the pelvis, the height of the reflection of peritoneum, and the strength of the levator ani have all been brought forward in explanation.

Pelvic herniæ occur almost invariably in adults, and usually in women; of 40 cases which Macready collected, 34 were in women. They do not appear in the middle line, but bulge more on one side: in the perineum or the ischio-rectal space in man, while in women they may occupy the ischio-rectal space or appear in the vagina or in the posterior part of the labium majus. The name "pudendal hernia" is given to the last variety.

Diagnosis is not difficult: an error is most likely to be made in the case of vaginal hernia. In two cases a vaginal hernia has been opened for an abscess. It may also be confounded with prolapse, rectocele, cystocele, uterine polypus, or vaginal cyst.

The **symptoms** of a hernia of the pelvic outlet are usually those of a hernia elsewhere. To these may be added numbness of the leg, difficulty in walking and of micturition.

Reduction is easily accomplished. If the neck of the sac has not sunk to the level of the perineum, it will be necessary to insert one or two fingers into the vagina or rectum, to complete the return of the

contents of the sac. A pessary is usually successful in retaining the rupture or an operation may be performed. Strangulation is not a frequent complication.

RECTAL HERNIA.

This rare form of hernia is seldom mentioned in surgical text-books. It appears either outside of the sphincter ani or just within, the sac being made up of the entire wall of the rectum, and the contents of the sac consisting of some of the abdominal or pelvic organs.

If the hernia is external, it may be mistaken for extensive prolapse of the rectum. If internal, it may simulate intussusception. Like other forms of rupture, it may be reducible, irreducible, or strangulated.

The treatment of reducible rectal hernia does not differ from that of prolapse. Operation, as far as can be judged by the small number of cases on record, is attended with much risk. Kelsey[1] has collected a number of cases of rectal hernia treated by operation, yet, inasmuch as most of the cases occurred in pre-antiseptic days, it would be hardly fair to estimate the mortality from these cases.

[1] *Diseases of the Rectum and Anus.*

SURGERY OF THE ALIMENTARY CANAL FROM THE PHARYNX TO THE ILEO-CÆCAL VALVE.

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ASSISTED BY FARRAR COBB, M. D.

THE ŒSOPHAGUS.

Congenital Malformations.—The embryological reason for the existence of these rare anomalies is still unknown. Though they are usually incompatible with life, in an occasional case nutrition can be carried on even without surgical aid. In certain very rare instances, fatal if left to themselves, life can be maintained after operative interference. The extreme types of malformations are generally found in subjects otherwise congenitally defective.

The rarity of these interesting conditions is shown by the meagre collection of cases in medical literature. Mackenzie[1] found 63 cases and Solis-Cohen[2] 60–70, of which 4 were in this country.

Malformations of the œsophagus may be divided into *six principal types:*

1. Central deficiency of the œsophagus, one or both of the extremities communicating with the respiratory tract. In this type the œsophagus is divided into two parts: the superior and posterior segment ends in a blind cul-de-sac; the lower and anterior segment opens into the trachea or into a bronchus. This is by far the most frequent form of malformation. Koenig[3] among 14 cases found 8 of this kind; Mackenzie[4] found 43 in a collection of 63 cases. Brosset[5] in reporting 2 cases of his own adds 3 cases collected since the publication of Mackenzie's statistics.

FIG. 150.

Congenital malformation of the œsophagus. Upper portion ends in a cul-de-sac; the lower portion opens into the trachea (Harvard Med. School, Warren Museum).

2. Simple communication between the œsophagus and the trachea—tracheo-œsophageal fistula.

3. Absence of the œsophagus for more or less of its length, the

[1] *Archives of Laryngology*, New York, Dec. 30, 1880.
[2] *Ashhurst's Encyclopedia*, vol. vi. p. 19.
[3] *Die Krankheiten des unteren Theils des Pharynx und Œsophagus*, 1880.
[4] *Diseases Throat and Nose*, 1884. [5] *Lyons médicale*, 1889, vol. lxi. p. 109.

upper and lower cul-de-sacs being joined by a fibrous cord. Mackenzie[1] collected 14 cases of this type.

4. Annular stricture of the œsophagus. (For adult cases *vide* Stricture of the Œsophagus, page 238.)

5. Dilatation of the œsophagus. Certain cases of simple general dilatation are probably congenital, but true diverticula are undoubtedly acquired, though their development may be favored by congenital defects in the muscular coats.

6. Double œsophagus with reunion at the cardiac end. In this deformity a simple membrane may divide the tube into two equal parts or a true bifurcation may exist.

Diagnosis.—If a new-born infant rejects or regurgitates unchanged all the milk or fluids taken, atresia of the œsophagus should be suspected. A tracheo-œsophageal communication will cause suffocation when the child attempts to nurse. Exploration with a sound or with a catheter will establish readily the diagnosis. In all cases of death from inanition, with regurgitation, malformation of the œsophagus should be considered. The condition is doubtless often overlooked, as Brosset has suggested.[2]

Prognosis and Treatment.—There can be but little relief for these cases by surgical means. In simple imperforations attempts may be made to find and unite the separate portions of the tube, as suggested by Holmes[3] and by Solis-Cohen.[4] The upper extremity may be exposed by cutting down upon a guide introduced through the pharynx; the lower extremity may then be sought for by careful dissection. If found, this may be united to the upper portion by sutures, as in resection of the œsophagus for stricture. If the lower end cannot be found, gastrostomy may be performed. This procedure will not only permit retrograde exploration, by which the lower end of the œsophagus may be found and the radical operation completed, but in the event of failure of the operation will also provide for permanent nutrition. No report of a trial of this method has been found. Gastrostomy, with or without œsophagotomy, seems the only practical mode of procedure in these cases. This operation has been done by Charles Steel[5] in the case of an infant twenty-four hours old. By means of gastrostomy and retrograde catheterization he found complete imperforation of the lower half of the œsophagus. The child died the next day.

In some of the types operation is unnecessary; indeed, nutrition can be carried on fairly well, so that the faulty condition is discovered only accidentally or as the result of remote changes. In others, though a theoretical remedy may suggest itself, demonstration of the anatomical relations is so difficult that the value of interference is extremely doubtful. Even if we can successfully reconstruct the parts at fault, the enfeebled powers of resistance in an infant that has swallowed no food since birth makes the prognosis practically hopeless.

Dilatations of the Œsophagus.—These are simple dilatations or ectasiæ and diverticula.

Simple dilatations are usually the result of a stenosis either in the lower part of the œsophagus or at the cardiac opening of the stomach.

[1] *Loc. cit.* [2] *Loc. cit.* [3] *System of Surgery.*
[4] *Ashhurst's Encyclopedia.* [5] *Lancet*, October 20, 1888.

The walls of the tube, distended with food above the constricted portion, yield and form a uniform dilatation. Rarely this process may be unilateral and form a limited diverticulum. Not all cases of stricture, however, cause dilatation, for in most, according to Von Ziemssen, the dilatation above a stricture is either very slight or wanting. In those rare instances of dilatation without stenosis in which the œsophagus takes the form of a spindle-shaped sac the walls are thickened and the distention excessive, as in Luschka's case.[1] The cause of this general dilatation is uncertain, though probably it is a loss of contractile power in the muscular coats from injuries or from inflammatory change. One or two cases of thinning of the walls, with fatty degeneration, have been reported, but most show great hypertrophy, especially of the muscular coats. Von Bergman,[2] Von Ziemssen and Zenker[3] cite 18 cases of this complete dilatation. Mermod[4] reports a case. Lichtenstein[5] reported a fatal case in a girl of nineteen who for seven years vomited persistently. At the autopsy the œsophagus was found dilated into an enormous pouch which compressed the lungs. Only one similar case has been reported, that of Strümpel in 1881, in which the dilatation was less excessive and the symptoms were less severe. Lichtenstein thought the cause chronic spasm of the cardia, with hypertrophy and dilatation of the œsophagus. Most of the recorded cases for many years had dysphagia, vomiting, and regurgitation; in some rumination was a repeated symptom. Very rarely a local dilatation, supposed to be congenital, has been found just above the diaphragm—the "Vormagen." Zenker[6] gives a description of such a condition found post-mortem in a seven-months-old child.

DIVERTICULA OF THE ŒSOPHAGUS.—The term "diverticulum" should be applied to those dilatations only which occupy a circumscribed area of the œsophagus and appear as sacciform bulgings or bag-like appendages of its wall. Accurately speaking, they are not dilatations at all, but pouch-like processes coming from the wall of the tube (Fig. 150).

True diverticula rarely result from strictures of the œsophagus, because in the latter condition the muscular coats are hypertrophied. This hypertrophy, especially marked in the circular fibres, occurs at an early period, is greatest close to the stricture, and extends for some distance above it. Such thickening of the muscular wall, aided by the scar-tissue of the stricture, prevents limited bulging. From a careful analysis of 100 autopsies on œsophageal stricture, Von Hacker[7] in 1889 found only 7 diverticula; these, without exception, either were false passages made by sounds or were the result of pericesophageal phlegmons produced by the same traumatic agent that caused the stricture.

Diverticula of the œsophagus are of two kinds—pulsion diverticula, caused by pressure from within; and traction diverticula, caused by traction on the outer wall.

Pulsion diverticula, though very rare, are of great clinical importance. They are almost without exception situated on the posterior wall just at or just above the junction of the œsophagus and the pharynx. They may

[1] *Virch. Archiv*, 1868, vol. xvii. p. 473.
[2] *Archiv f. klin. Chir.*, vol. xliii. No. 1.
[3] *Loc. cit.*
[4] *Revue méd. de la Suisse Rom.*, 1887, vol. vii. p. 422.
[5] *Deutsch. med. Woch.*, April 2, 1891.
[6] *Ziemssen's Encyclopedia*, loc. cit.
[7] Von Bergmann, *Archiv für klin. Chir.*, vol. xliii. No. 1.

appear either in the form of a small sac-like protrusion or in the form of a large pouch with a narrow neck suspended between the posterior wall of the œsophagus and the spine. The walls of the pouch are thickened, and consist only of the mucous and submucous tissues, with an external fibrous layer, the muscular coat persisting only about the neck of the sac.

A pulsion diverticulum has been aptly defined as a hernia of the mucous membrane through the inferior constrictor of the pharynx. The pressure exerted by the œsophagus in deglutition gradually forces out some portion of the wall less resistant than the rest, and thus forms a constantly growing pouch. The process, as Von Bergmann [1] suggests, is undoubtedly due to some previous thinning and weakening of the wall, a muscular atrophy, or a slight depression. The rarity of pulsion diverticula is shown by Von Ziemssen and Zenker,[2] who collected only 27 cases in the literature of a hundred years. They are undoubtedly more common than this collection would show, for probably many cases either escape observation or are not reported. Solis-Cohen [3] takes this view, for he has seen several cases. In recent years Kocher [4] mentions 2 cases treated successfully by operation. Carl Dugge,[5] reporting a fatal case in a man of sixty-three, could find but 12 similar instances in the literature of the six years preceding 1893. Schwarzenbach [6] operated successfully on a case. Butlin,[7] Chevasse,[8] Von Bergmann,[9] Berkans,[10] and Rosenthal [11] have each reported cases since 1888. One case has occurred in my own practice.

The pulsion diverticulum occurs by far the more frequently in males: the 22 cases collected by Von Ziemssen and Zenker [12] were all males; 2 cases occurring in women have been reported by König,[13] 1 by Whitehead [14] in 1891, 1 by König [15] in 1894, and 1 operated upon Mixter [16] in 1894. Most of the cases have been discovered late in life. Out of 10 analyzed by Von Ziemssen and Zenker, 8 presented their symptoms after the fortieth year.

Diverticula are progressive in their course. The weakening in the œsophageal wall doubtless exists for a long time before the first subjective symptom appears. As the pouch increases in size and retains more and more food, dilatation in the thinned and weakened œsophageal wall progresses with greater and greater rapidity until the passage of food becomes markedly embarrassed.

Symptoms and Diagnosis.—Œsophageal diverticula give no characteristic signs until the sac, when distended with food, is so large that the œsophagus is compressed. Before this time, however, there is doubtless some slight variation from the normal physiological act of swallowing—some hesitation, or even temporary arrest of the bolus, without lodgement. With the formation of a distinct pouch dysphagia, regurgitation, rumination, and vomiting may occur. In one instance in the writer's experience no food could pass until the diverticulum had first

[1] *Loc. cit.* [2] *Loc. cit.* [3] *Ashhurst's Encyclopædia*, loc. cit.
[4] *Correspondenzblatt für Schweizer Aertze*, April 15, 1892.
[5] *Münch. med. Woch.*, 1893, p. 529. [6] *Wiener med. Woch.*, 1893, p. 455.
[7] *Med. Chir. Trans.*, vol. lxxvi. p. 269. [8] *Brit. Med. Journ.*, Jan. 24, 1891.
[9] *Loc. cit.* [10] *Berlin. klin. Woch.*, 1889, p. 227. [11] *Ibid.*, 1890, No. 52.
[12] *Loc. cit.* [13] *Der Chirurgie des Pharynx und Œsophagus.* [14] *Lancet*, Jan. 3, 1891.
[15] *Berlin. klin. Woch.*, No. 31. [16] *Trans. Am. Surg. Ass'n.*, 1895, p. 357.

been filled. After completion of the meal the patient would empty the pouch by pressure of the hand, either rejecting or swallowing the food first taken. As the obstruction increases deglutition becomes difficult and painful. Most of the cases die from starvation unless relieved by radical measures. The distended pouch can sometimes be seen or felt in the neck. The sound if passed into the diverticulum will be arrested at its base. By combined external and internal manipulations the size and shape of the sac can be estimated. In large diverticula the distended sac may appear as a diffuse or circumscribed tumor on one or both sides of the neck. Sometimes the pouch can be emptied by pressure on this swelling and the contents forced into the mouth. Much diagnostic importance is attached to the presence of such a tumor by all who have had experience in these cases, save Von Bergmann,[1] who rarely found a tumor in the neck after eating. As the diverticulum becomes distended with food the œsophagus and all the structures in the neck are pressed upon. Whenever the contents of the sac cannot be dislodged they decompose and lead to ulceration of the sac, with the dangers of sepsis from retropharyngeal or periœsophageal extravasations. Rosenthal[2] first called attention to the fetid breath of these cases as a trustworthy diagnostic sign.

The **diagnosis** between diverticula and other obstructions in the œsophagus can usually be made by instrumental explorations. If the sound sometimes passes down the œsophagus without resistance, and sometimes is arrested, the existence of a diverticulum is very probable. Strictures, malignant or benign, can hardly be mistaken for diverticula if the history is carefully considered. Occasionally valve-like folds above the stricture will closely simulate a diverticulum. Even in these cases one is unlikely to overlook a pouch after repeated examinations. Diffuse dilatation may cause many of the symptoms found in cases of œsophageal pouch, but it is an extremely rare affection.

Cancerous strictures are usually situated low down in the œsophagus. If high up, an irregular mass, usually with enlargement of the cervical glands, can often be felt in the neck. In cancerous stricture the smooth tip of the probang passes over a hard, ulcerated, and uneven surface for a considerable distance, and causes more or less hemorrhage. Diverticula are always high up in the œsophagus, where the sound, unless it enters and goes to the bottom of a deep sac, will be arrested. In most cases of malignant stricture marked cancerous cachexia exists, in addition to the symptoms caused by insufficient food. When œsophageal cancer causes symptoms, it usually has begun to break down, and the sound will bring up blood and bits of tissue which can be examined by the microscope.

Spasmodic stricture is hardly likely to escape careful and repeated observations. In this condition gentle and prolonged pressure by means of a large sound will usually overcome the resistance.

Treatment.—Until recent years the only treatment has been palliative. The intermittent or continual passage of sounds, rectal alimentation, the introduction of liquid food through a stomach-tube, and electric stimulation of the walls of the œsophagus met with little success beyond brief prolongation of life. One case, that of a man of

[1] *Loc. cit.*

[2] *Berlin. klin. Woch.*, 1890, No. 52.

fifty-two, has been reported as cured by the continual use of sounds.[1] Neukirsch[2] reports a case in which he effected a cure by requiring the patient to take all his food in the horizontal position. Von Bergmann[3] refers to these two cases as the only ones of spontanous or non-operative cure on record.

It is only within recent years that operations for the relief of this distressing condition have been attempted. Solis-Cohen[4] could find no report of such cases. In Whitehead's case[5] gastrostomy was done six years before death. Kocher[6] in 1892 operated successfully in 2 cases. Von Bergmann[7] in 1892 reported a successful case in which he excised the sac through an incision along the border of the sterno-mastoid, and tamponed the external and œsophageal wounds with iodoform gauze. A fistula persisted for twelve weeks or more. Schwarzenbach[8] reported a successful case in 1893. Butlin[9] was the first to close the œsophageal wound with sutures after excision of the diverticulum; a fistula resulted which closed in a few days. Mixter[10] of Boston in 1894 operated successfully, and König[11] reported 2 cases, both of which recovered. A successful case was also reported by Schaffhausen.[12]

FIG. 151.

Traction diverticulum which was adherent to a cheesy bronchial gland. The cut shows the external œsophageal wall with the diverticulum artificially distended (Warren Museum).

The œsophagus having been exposed as in external œsophagotomy, the pouch must be dissected and freed from all its surroundings until its extent, position, and relations can be determined. Its base should next be divided by means of either scissors or scalpel, a clean-cut wound being left in the healthy and unaltered œsophageal wall. This opening may be left with a tube, or it may be closed immediately by interrupted sutures, the edges of the œsophageal wound being inverted as in intestinal suture. The latter procedure, first employed by Butlin, seems preferable to the older method of secondary closure, unless further experience should show it to be more dangerous. The possibility of septic extravasations and periœsophageal phlegmons constitutes the chief objection to immediate suture of both œsophagus and external wound. Such complications are likely to arise only in cases themselves necessarily septic, such as perforations and abscesses from the impaction of foreign bodies. Under aseptic conditions no such objection exists, and immediate closure seems justifiable. It may be wiser for the present, as a compromise measure, to close the œsophageal opening and to pack the external wound for a few days with gauze.

When the diverticulum communicates with the œsophagus by an opening so large that lateral closure must cause narrowing of the tube, the

[1] *Berkhan's Berlin. klin. Woch.*, 1888, p. 227.
[2] *Deut. Archiv für klin. Med.*, vol. xxxvi. [3] *Loc. cit.* [4] *Loc. cit.* [5] *Loc. cit.*
[6] *Loc. cit.* [7] *Loc. cit.* [8] *Loc. cit.* [9] *Loc. cit.* [10] *Loc. cit.*
[11] *Berlin. klin. Woch.*, 1894, No. 31.
[12] *Correspondenzblatt für Schweizer Aertze*, 1894, No. 24.

stitches may be placed longitudinally, or the whole lumen may be resected and sutured, as in similar intestinal operations.

The after-treatment is the same as in external œsophagotomy.

Traction Diverticula.—These are produced by the contracting scar-tissue which results from suppurating bronchial or mediastinal glands In the great majority of cases the gland-infection proceeds from pulmonary tuberculosis. The diverticula thus formed are small, being seldom larger than a hazelnut, though several may be united at the base. They are always situated on the anterior wall of the œsophagus in close relation with the bronchus, and are of far more frequent occurrence than the pulsion diverticula. Perforations may take place from without or from within a traction diverticulum. They may result from the ulceration of the original disease, from the lodgement of a foreign body in the pouch, or from the forcible use of the œsophageal sound. Perforation takes place most often into one of the bronchi, but it has been known to involve the pericardium, the pleuræ, or the great vessels.

Wounds and Ruptures of the Œsophagus.—Wounds of the œsophagus may be divided into two classes: (*a*) those from without, and (*b*) those from within, the œsophagus. Wounds from without may be incised, punctured, lacerated, or contused. In the majority of cases the injury is caused by a stab, a cut, or a gunshot. The wounds may vary in extent, in depth, and in the number of important structures involved. It is rare for the œsophagus to be injured unless the trachea and great vessels are wounded also. Lacerated wounds are usually caused by bullets. The commonest instance of incised wound of the œsophagus is the ordinary cut throat, yet it is very unusual to find the œsophagus thus injured, most suicides cutting into the larynx and pharynx. The œsophagus is so deeply placed that a slash could hardly be made from side to side deep enough to injure it without dividing also the common carotid or the internal jugular, or both. In penetrating wounds of the neck in which the air-passages or the large vessels are injured the opening in the œsophagus may be masked by the more immediately alarming symptoms from the trachea or from the blood-vessels. Great care should therefore be taken to make sure that the œsophagus is intact. In those cases in which the wound of the œsophagus is not at first detected the escape of food during deglutition makes the diagnosis certain, though too late for immediate closure of the wound.

Wounds from within the œsophagus are usually caused by foreign bodies with sharp edges. Many such substances are known to have caused injury to the mucous wall, among them pins, nails, shells, dental plates, and bones. The substance swallowed must have a ragged, sharp, or cutting edge, which pierces the coats of the œsophagus as the object is forced downward. Jugglers have occasionally wounded the œsophagus by swallowing swords. Internal wounds have also been caused by the unskilful passage of surgical instruments in explorations or in attempts at the removal of foreign bodies. In the latter operation some of the instruments favor lacerations, even in the hands of the most skilful, especially if the mucous membrane of the œsophagus lies in folds so as to be easily caught. When attempts are made to extract foreign bodies by means of such instruments as the coin-probang great damage, or even fatal injury, may be caused. I have known the coin-probang to

be immovably caught under an impacted dental plate near the cardiac orifice. The instrument could not be detached nor could the plate be moved. The metal tip of the coin-catcher finally gave way and the handle was withdrawn. In this case the foreign body had been lodged in this position eleven months. It is remarkable that no injury to the œsophagus resulted, for the plate was impacted directly behind the left auricle, and had undoubtedly caused lateral ulcerations. Wounds from exploration of the healthy œsophagus are extremely unusual.

Diagnosis.—Large open wounds in the neck in which the œsophagus is more or less involved offer no difficulties of diagnosis. The diagnosis is often difficult, or even impossible, in punctured wounds or in stabs in which the opening is small. The escape of food or of saliva from such a wound makes an injury to the œsophagus apparent; the regurgitation of blood from the mouth in punctured wounds of the neck makes such an injury probable. Pain in the region of the œsophagus, with dyspnœa, hiccough, and thirst, is a suggestive symptom. When other structures are involved with the œsophageal wound the symptoms of the latter may be masked. Penetration into the mediastinum, the pleura, the bronchi, the great vessels, or the pericardium gives rise to characteristic signs. If these grave complications are not immediately fatal, they are usually so in the course of a short time either from sepsis or from hemorrhage. Contused wounds of the œsophagus may cause great swelling of the neck, with dysphagia and dyspnœa. In such cases the diagnosis is not easy.

Wounds from within, if the œsophagus is perforated, are usually fatal. The prominent symptoms, with the history, are pain, dysphagia, hæmatemesis, and fever. Cervical pain and swelling would indicate a perforation high up in the œsophagus; mediastinal pain, cough, dyspnœa, with or without hiccough and vomiting, one low down in the œsophagus. A perforation involving the mediastinum, the pericardium, the bronchi, or the great vessels is almost surely fatal. When the pleura is perforated the prognosis, though unfavorable, is not hopeless. Slight, non-perforating, lacerated wounds of the œsophagus, if the parts are kept perfectly quiet, usually recover without serious symptoms.

Treatment.—After external incised wounds the œsophagus may be closed immediately, or the older method of leaving in a tube may be adopted. If the œsophagus is sutured, a strand of gauze should be left for a few days to provide for possible leakage and sepsis. Should signs of deep cervical infection ensue, free incision is demanded. When the perforation involves the heart, lungs, or great vessels only palliative treatment with absolute rest is advisable. A septic pleurisy from this cause may be treated like any other.

RUPTURES OF THE ŒSOPHAGUS.—Ruptures of the healthy œsophagus are very rare, and are usually caused by violent vomiting or retching. Zenker and Von Ziemssen refer to 9 genuine cases. Fitz[1] could find, up to 1877, but 2 authentic cases besides his own. Solis-Cohen[2] refers to 13 cases collected by Mackenzie. Another case is reported by Morley[3] in which a linear tear began at the cardia. The patient was an

[1] *Journ. Amer. Med. Assoc.*, 1877.
[2] *Ashhurst's Encyclopedia.*
[3] *Northwestern Lancet*, April 1, 1891.

alcoholic man and the accident happened during violent exertion. The tear is usually linear, and the mucous membrane suffers most. In 6 out of Solis-Cohen's 14 cases the rupture extended into the pleural cavity, and was caused, almost without exception, by vomiting in attempts to dislodge a foreign body from the œsophagus. The patients in whom this has occurred have been invariably alcoholic and high livers. Fitz contends that most of the cases were due to post-mortem œsophagomalacia. Von Ziemssen and Zenker[1] hold that the malacia is ante-mortem, and that, occurring in alcoholic subjects, it predisposes to rupture. The patient may rally from the profound shock of the accident and live seven or eight days, in which event death takes place from sepsis and gangrene of the mediastinum and pleuræ. Diagnosis in the beginning is almost impossible. In but one instance thus far reported was it made ante-mortem.

FIG. 152.

Laceration of the œsophagus caused by violent efforts to expel a foreign body. Death in eight days from pyæmia (Warren Museum, Harvard Medical School).

Symptoms.—The first symptom of œsophageal rupture is sudden acute pain, occurring usually during violent attacks of vomiting. The patient feels something give way, and profound shock immediately supervenes. Hæmatemesis, if present, confirms the diagnosis. Emphysema in the neck may appear early and become extensive. Auscultation of the œsophagus, when rupture is suspected, may give information, as suggested by Hamburger. In some cases nothing calls attention to the œsophagus as the seat of the lesion.

The **prognosis** is practically hopeless; all the cases thus far reported have been fatal.

Treatment.—In those rare cases in which a diagnosis is made the treatment must be palliative. If there is a rupture of the œsophagus high up, an exploration may be made. In such cases, on theoretical grounds, the wound of exploration should be kept open and the patient fed by a tube through the rupture, as in external œsophagotomy.

PERFORATION OF THE ŒSOPHAGUS FROM OTHER CAUSES.—Besides wounds and ruptures, we may have as causes of œsophageal perforation—

Primary.

1. Traction diverticula.
2. Malignant disease.
3. Foreign bodies.
4. Corrosive solutions.
5. Peptic ulcers of the œsophagus.

[1] *Loc. cit.*

Secondary.

1. Diseases of the bronchial glands.
2. Mediastinal suppuration from vertebral caries.
3. Suppuration or gangrene of trachea or lungs.
4. Pressure from without, aortic aneurysms, etc.

In the *primary perforations*, in which extravasation takes place from within the tube, those symptoms may be expected which are given above in connection with wounds. When perforation takes place from without, as in any of the secondary causes enumerated, there may be vomiting of pus or blood. When abscesses evacuate themselves in this way, recovery may follow. In the rupture of aneurysms into the œsophagus death takes place during a deluge of blood from the mouth and nose.

Perforations from *traction diverticula*, from *malignant disease*, from *foreign bodies*, are considered elsewhere. Primary perforations from *corrosive poisons* are very rare, and may be suspected after the swallowing of escharotics if the usual symptoms of extravasation are present.

The existence of *peptic ulcers* is denied by some authorities; others maintain that they are a true cause of destruction of the œsophageal wall. Zenker[1] doubts their existence. Huwald[2] reports a case, fatal from hemorrhage, in which the diagnosis was ulcer of the stomach. The autopsy showed just above the cardiac orifice a well-defined ulcer, which had perforated into the lesser omental cavity. Huwald found 16 cases in all literature. Ewald and Ortmann[3] believe in the existence of these ulcers. Guiteras[4] reports an authentic case of fatal perforation from this cause.

The treatment of perforations from the causes under consideration differs in no way from the treatment of those perforations already described. Unless the results of extravasation are limited to the neck, where they can be drained, little besides palliation can be done. If the patient does not succumb to the immediate effects of the perforation, the œsophagus should be kept absolutely at rest and the patient fed by the rectum or through a stomach-tube. That perforations from these causes are not always hopeless is shown by a case of Mixter's.[5] In this case, after the removal of a retro-œsophageal myxosarcoma, an operation which was preceded by tracheotomy for pressure-dyspnœa, the patient began to expel from the trachea liquids taken by the mouth. Examination showed a tracheo-œsophageal communication. Four weeks from the operation the patient was convalescing, having been fed entirely through a stomach-tube for three weeks. It is essential in all such cases to interdict all passage of liquids through the œsophagus, resorting to rectal feeding, to the use of the stomach-tube, or even to gastrostomy. In many instances the disease which causes the perforation, whether it be local or constitutional, is such as to interfere seriously with recovery, even if miraculous repair could be made in inaccessible places. It is quite possible that by judicious palliation spontaneous recovery may follow perforations situated far beyond surgical reach.

Foreign Bodies in the Œsophagus.—Foreign bodies in great

[1] *Loc. cit.*
[2] *Inaugural Dissertation*, 1893.
[3] *Zeitschrift für klin. Med.*, 1892.
[4] *Internat. Med. Mag.*, Nov., 1894.
[5] *Boston Medical and Surgical Journal*, July 4, 1895.

variety may become impacted in the œsophagus. Some lodge because of their size; others, small enough to pass, are of such shape as to be easily caught and held by the mucous membrane. Those with sharp points or with cutting edges are the most dangerous, because their impaction frequently leads to perforation. Round bodies small enough to enter the œsophagus almost always reach the stomach. Complete obstruction by such a body is extremely rare. Objects too large to enter the œsophagus sometimes lodge in the pharynx and cause death by suffocation. This accident is not uncommon in old people who try to swallow large pieces of meat without sufficient mastication. Death from this cause is not infrequent in almshouses. Temporary lodgement of such a bolus in the œsophagus may take place. Among substances that have become lodged may be mentioned spoons, knives, pins, thermometers, coins, pieces of meat, fruit-stones, bones of fish and other animals—in fact, any substance that may be held in the mouth and swallowed accidentally or with suicidal intent. A number of different bodies may be swallowed by the same individual. In one case an insane woman swallowed an open safety-pin. This, getting lodged in the œsophagus, was pushed down by a steel crochet-needle, which was itself thereupon swallowed. A gold pencil followed next, and finally a paper of pins. The gold pencil, with a number of pins, was passed *per anum;* the open safety-pin was found sticking in the pylorus, from which it was successfully removed. The steel crochet-needle never appeared.[1] Artificial teeth are perhaps more commonly impacted than any other foreign body, from the habit people have of wearing them during the night. The plates are swallowed not infrequently during mastication, and occasionally when the wearer is intoxicated. Bones of fish are especially dangerous from their sharp points and edges. Coins are frequently swallowed by children. The one-cent piece (diameter, 1. 9 cm.) or the five-cent nickel (diameter, 2.1 cm.) seldom if ever becomes lodged, even in infants. Coins smaller than the silver dollar or the five-franc piece rarely become impacted in the adult œsophagus. The larger coins, once having entered the œsophagus, usually lodge near the cardia, where they are especially dangerous from their close proximity to the heart, the pleuræ, and the large vessels.

In the normal œsophagus there are three points of narrowing at which a foreign body is likely to be caught: (1) At the pharyngeal end; (2) at the crossing of the bronchus; (3) just above the cardia. Rounded or flattened bodies will become lodged, if at all, at one of these three points. Sharp or irregular bodies may become impacted in any part of the œsophagus. The most common seat of impaction is the cervical portion; lodgement at the cardia is much less frequent, and impaction at the crossing of the bronchus is very unusual.

The **symptoms** of impaction are pain, constriction of the chest, inability to swallow, and the sensation of something sticking to the gullet. If the obstruction is low down and complete, swallowing may be possible, but the bolus is soon regurgitated. Most foreign bodies, however, do not completely close the lumen of the œsophagus. Coins and tooth-plates often are caught in a vertical plane, and therefore do not cause complete obstruction. In two cases of the writer's[2] a tooth-

[1] *Boston Medical and Surgical Journal*, vol. cxxiii. p. 77, 1890. [2] *Ibid.*, loc. cit.

plate was impacted for eleven months. Deglutition was difficult and the general nutrition considerably impaired, though there was no permanent injury to the œsophageal wall.

The initial symptoms of impaction may subside slowly as the œsophagus becomes tolerant of the foreign body, or they may increase in severity with the development of periœsophageal phlegmons. In the latter event the local symptoms become more marked and a general systemic infection evident. The pulse and temperature rise, the pain and constriction increase, and the general condition becomes ominous. Death usually follows in three or four days, unless by prompt surgical interference the body is removed and the abscess drained. Mediastinal phlegmons are almost invariably fatal from their inaccessibility. Cervical inflammations are more favorable.

Hemorrhage usually takes place from the large vessels, and is therefore immediately fatal. Bleeding may result from the erosion of small arteries, and gradually give rise to the symptoms of exsanguination. In all operations for long-continued impaction the possibility of immediate death must be borne in mind, for the perforation may be imminent at the time of interference.

When the foreign body remains impacted for a long time without perforation the symptoms of progressive malnutrition due to insufficient food usually appear. In one such case the weight was reduced from 180 to 110 pounds, though the patient was able to swallow liquids with ease. In this instance the left pleura was involved. In another, in which the tooth-plate remained lodged in the upper part of the œsophagus for eleven months, the general strength was not affected. In the absence of actual perforation more or less chronic periœsophageal inflammation doubtless exists.

If the impaction is above the aortic arch, the recurrent laryngeal nerves are occasionally involved, either by pressure or by direct inflammation. Such complication is shown by paralysis of the posterior cricoarytenoid muscle, with resulting hoarseness. This symptom is of value in determining the seat of the foreign body.

The exact shape and situation of the foreign body have an important bearing upon the subsequent course. A tooth-plate lodged in the neck in a lateral plane may cause neither perforation nor abscess. The œsophageal walls are extremely tolerant, unless the edge of the body is sharp enough to cut. A tooth-plate may remain impacted a year or more in the lower end of the œsophagus, not only without injury to the contiguous structures, but without permanent damage even to the mucous membrane. Not that the impaction of so large a body is without danger; it is justly deemed an extremely serious accident. Doubtless many cases die from hemorrhage, extravasation, or chronic sepsis. A foreign body, if very large, may cause sudden death from suffocation by pressure on the trachea or by spasm of the glottis. In the latter case the recurrent laryngeal nerve is usually affected. When the object has sharp angles or cutting edges hemorrhage may take place in a comparatively short time after impaction; in other cases it may result from prolonged pressure. Ulceration and perforation, with their complications, may follow early or late according to the shape, size, and situation of the body (Fig. 153). Foreign bodies may produce fatal symptoms in the course of a

few days or even hours. They may remain impacted without symptoms for years. After being held in the œsophagus for weeks or months they may become dislodged spontaneously, and be passed *per anum*, as in Rozewig's[1] case, in which a dental plate was passed by rectum seven weeks after impaction. In a case of Porter's a tooth-plate, caught in the upper part of the œsophagus, was detached and brought up within view, when it slipped past into the œsophagus, thence to the stomach, and finally lodged at the anus. In children it is rare to have foreign bodies impacted in the œsophagus. According to the statistics of Alexander of Moscow, up to 1891, out of 44,000 cases of children's diseases, he had found only 7 of foreign body in the œsophagus.

FIG. 153.

Ulceration of the œsophagus opening into the upper part of the treachea (from a woman aged forty-two who had a stricture for twenty-four years, caused by having swallowed a chicken-bone) (Warren Museum).

Diagnosis.—The use of the probang renders easy the detection of a foreign body in the œsophagus. When its nature is uncertain the ivory point striking the substance may give important information as to its composition. The history may be absent in children, suicides, and lunatics. From other patients a more or less intelligent idea of the shape and size of the foreign body can be obtained. When from the history and subjective signs the impaction of a foreign body in the œsophagus is suspected, the diagnosis may be confirmed by external palpation, by digital exploration through the mouth, by internal inspection, and by the passage of sounds. A body impacted high in the œsophagus may cause a perceptible tumor in the left side of the neck. If no tumor is present, the body may be felt at times by digital examination from the outside. Internal exploration with the finger can detect a body only at the beginning of the œsophagus. By inspection through the mouth the object, when high up, can sometimes be seen. The œsophagoscope may be employed to determine the position, shape, and size, though the difficulties and discomforts of its use render the instrument of doubtful advantage. The diagnosis practically depends upon the use of sounds of various kinds, by which the exact situation of the body can be demonstrated. Some idea can be obtained also of its consistency and size.

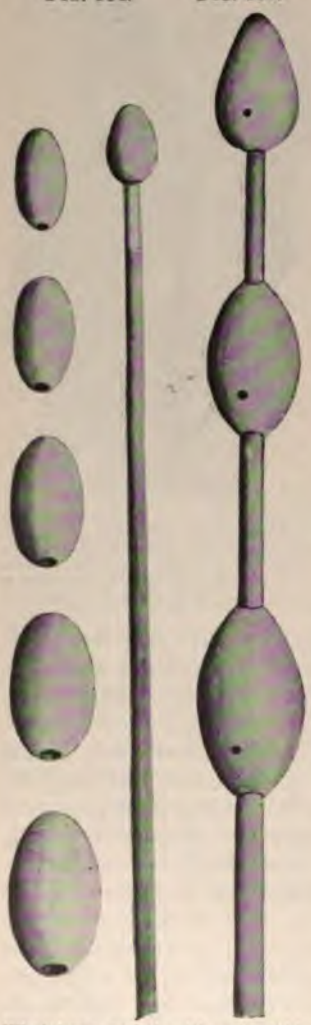
The instruments used for exploring the œsophagus are—(1) The ordinary whalebone sound with adjustable ivory olive-shaped tips (Langenbeck's sound); (2) sounds similar to the former, but with metallic tips; (3) special resonating sounds (Duplay's) with ear-piece attached; (4) bougies (Figs. 154 and 155.)

Œsophageal instruments are most easily passed with the patient sitting in a straight-backed chair. The body should be erect, with the head thrown back so that the roof of the mouth, the pharynx, and the œsoph-

[1] *Brit. Med. Journ.*, Dec. 1, 1891.

agus may be brought as nearly as possible into a straight line. Even in this position the vault of the mouth makes a marked angle with the line of the pharynx and œsophagus. The tongue and anterior pharyngeal wall are now pulled forward with the left index finger placed upon the base of the tongue. The pharynx is thus opened and put upon the stretch. In the mean time, the instrument, lubricated with oil or with glycerin, is passed backward and downward with the right hand until it strikes the posterior pharyngeal wall, by which it is guided in its descent into the opening of the œsophagus. If any obstruction is encountered, no force should be used, for at this point in the healthy individual there should be no great resistance, and violence might cause laceration or even rupture of the pharynx. Laxity of the pharyngeal wall, with pouch-like depressions at its junction with the œsophagus, sometimes causes obstruction to the passage of the sound. Force will increase the difficulty; gentle and repeated manipulations will result in the easy passage of the bulb.

Fig. 154. Fig. 155.



Whalebone sound with adjustable ivory tips.

Once in the œsophagus, the instrument should be carefully pushed until the foreign body is detected or until the stomach is reached. If nothing is felt in the downward passage of the sound, it should be withdrawn as far as the pharynx and again pushed into the stomach. At times the body will be felt only on the withdrawal of the sound. Failure to touch an abnormal substance does not demonstrate its absence. Gentle tapping against the obstruction may indicate its nature. The point on the probang opposite the incisor teeth should be marked, and on withdrawal of the instrument the distance should be measured. With the patient in the horizontal position it is always difficult to pass the instrument into the œsophagus, probably on account of the relaxed and pouch-like state of the pharynx. The difficulty may be obviated by placing the patient in the position of Roser, by which the folds of the pharynx are straightened. If, in spite of failure to detect it with the sound, there is good reason to suspect the presence of a foreign body, the exploration should not be abandoned without resorting to the largest-sized probangs. Even these may fail to detect a flat body impacted against the side of the œsophagus or caught vertically. Other instruments may then be used, the best under such circumstances being the bristle probang.

In doubtful cases the œsophagoscope may be used. The principle of laryngoscopy was first applied to the œsophagus by Stoerk in 1866. The latest œsophagoscopes have been Leiter's pan-electroscope and one invented by Löwe of Berlin.[1] The œsophagoscope, even in its present perfected state, is limited in its use to the upper third of the œsophagus. It is not as yet of general use or of great practical value. Von Hacker[2] has reported success in using the Leiter tubes for the diagnosis of œsophageal conditions, and gives 100 cases of cancer in which the œsophagoscope was very useful. In several cases he has seen foreign bodies and removed them. Löwe's instrument is recent and has had little trial, though it is said to possess great advantages.

Treatment.—In the treatment of foreign bodies in the œsophagus the exact location of the impaction is of the greatest importance, for the symptoms, course, prognosis, and treatment depend upon the anatomical surroundings. In a series of investigations made on the cadaver I found that the average distance from the incisors to the cardiac orifice is 14½ inches.[3] In the ordinary individual, therefore, if the foreign body is situated 14½ inches below the incisors, it is at or near the cardiac orifice; if 9 inches below, it is behind or near the arch of the aorta. A clear recognition of these two points is essential, not only that one may determine the proper course of treatment, but that he may realize the importance of the surrounding organs. A body, for example, with sharp edges, known to be separated from the transverse portion of the arch of the aorta by only the combined thickness of the artery and of the gullet, demands immediate removal; a less intimate proximity will justify more conservative measures. In the event of failure by the use of instruments through the mouth, a large coin or a tooth-plate, known to be in one of the more dangerous positions, should be removed by external œsophagotomy, or by even so hazardous an operation as digital exploration through the stomach. The selection of route depends also upon the situation of the foreign body. Impaction at the cardia cannot always be relieved by external œsophagotomy, even though instrumentation can be more intelligently directed through the cervical wound than through the mouth. Digital exploration of every portion of the œsophagus is possible, though when that canal is unusually long it is extremely difficult to reach to the point halfway between the neck and the stomach. I have many times demonstrated on the cadaver the possibility of removing coins from the œsophagus either by opening the stomach or by opening the neck. I have never seen a subject in whose œsophagus I could not bring my fingers together by combined gastrotomy and external œsophagotomy. Not that it is a feasible plan in every instance to reach the foreign body with the finger, but by one route or the other, or by both combined, nearly every impacted substance can be intelligently dislodged and removed.

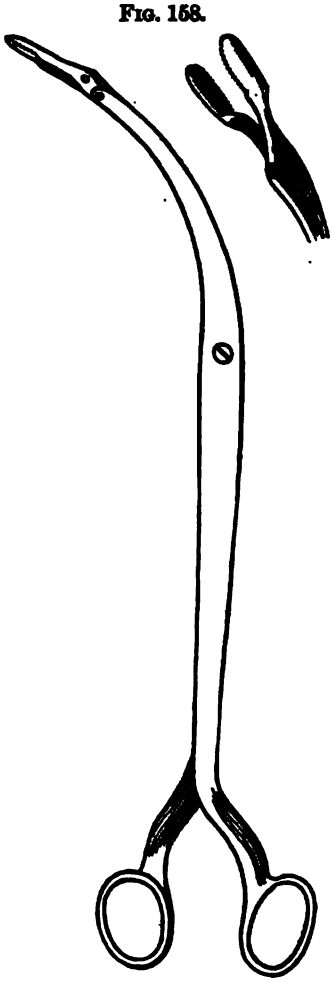
Foreign bodies may be ejected spontaneously by coughing or vomiting or they may be dislodged by massage. Extraction may be accomplished through the mouth by means of forceps or sound, by downward dislodgement, by external œsophagotomy, by gastrostomy or gastrotomy and removal from below.

[1] *Deut. med. Woch.*, 1893, p. 271.
[2] *Wiener klin. Woch.*, 1889, No. 23, and *ibid.*, 1894, Nos. 49, 50.
[3] *Lancet*, 1887, vol. ii. p. 707.

Emetics, recommended and used by Dieffenbach, should be employed only in exceptional cases. If the body is sharp or pointed, the danger of perforation is increased by forced emesis. Moreover, if the body is large and firmly impacted, there is a possibility of rupture of the œsophagus. Emetics, if used at all, should be employed at the very outset. In many cases, particularly if the body is small, the swallowing of liquids or of large boluses may effect a successful dislodgement. Massage of the neck has been successful. In two cases Polikier of Warsaw succeeded by this method in loosening a coin in children.

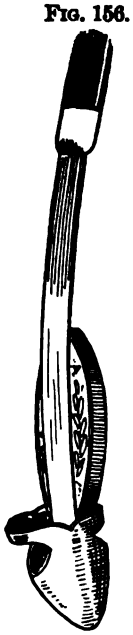
For the removal of foreign bodies through the mouth numerous instruments have been devised, among them Graefe's coin-catcher, the ring coin-catcher, Cusco's, Cloquet's, and Bond's forceps, Gama's revolving forceps, sponge probangs, and Sayre's hair or bristle probang. (Figs. 156–161). These instruments must be used with extreme care to avoid rupturing the œsophagus, tearing or abrading the mucous membrane, and finally allowing them to become themselves impacted. In

FIG. 158.



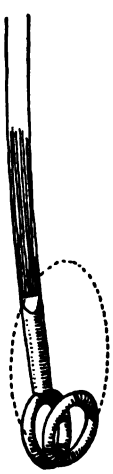
Cusco's forceps.

FIG. 156.



Graefe's coin-catcher.

FIG. 157.



Ring coin-catcher.

case serious damage is done the œsophagus, the treatment already indicated in such accidents must be employed. If the instrument gets impacted so that it cannot be withdrawn, excessive force must not be used. If, after the use of moderate force and after every conceivable manipu-

lation, the instrument still remains impacted, either external œsophagotomy or gastrotomy is demanded, according to the location of the foreign

FIG. 159.

Sponge probang.

body. Not only will the dislodgement of the instrument be accomplished in this manner, but also the removal of the foreign body. The

FIG. 160.

Gama's revolving forceps.

accidental impaction of the instrument will make imperative certain methods of extraction hitherto employed only as a last resort after the septic complications have rendered the prognosis unfavorable.

Œsophageal instruments should be used with the patient in the erect position already indicated, with the head thrown back. Ether should not be used unless it is absolutely necessary. If the manipulations cannot be successfully conducted without an anæsthetic, the patient should be placed in the position of Roser. Glycerin or oil may be used for lubrication. Pushing the foreign body through the œsophagus must be attempted only when the object is smooth and round or soft and digestible. Sharp or irregular bodies forced downward may seriously injure the œsophagus. Gentle efforts, however, may be made to dislodge any substance. When by reasonable efforts an impacted foreign body cannot be detached in the manner already described, external œsophagotomy or gastrotomy should be performed immediately, before symptoms of perforation appear. It is not advisable to delay in the hope that dislodgement will be easier as time goes by, for the force of the impaction increases rather than diminishes with time. The choice between external œsophagotomy and gastrotomy depends upon the situation of the body. When the object is tightly grasped near the cardiac orifice, instruments introduced through the wound of an external œsophagotomy cannot always be intelligently directed. It may then be necessary to

use forcible, and therefore dangerous, means of extraction. Moreover, when the body is at the cardia it is impossible to determine its position, its outlines, or its points of pressure. This can be done only by digital exploration through the stomach. The safety of exploration through the stomach justifies the selection of this route when there is good reason to suppose that great difficulty will be encountered in starting the foreign body. On the other hand, when the seat of impaction is so far above the cardia that it cannot be reached by the hand introduced through the stomach, external œsophagotomy should be selected.

FIG. 161.

Bristle probang.

External Œsophagotomy. — The first œsophagotomy for the removal of a foreign body was done by Goursald in 1738. From that time to 1800 there were but three other cases. Very few of these operations had been performed before the introduction of antiseptic surgery. From 1880 to 1895 there were 71 operations. Fischer[1] collected 120 cases. Egloff[2] added 15 cases to Fischer's 120, making 135 œsophagotomies done for the removal of foreign bodies from 1738 to 1894. Most of these operations were performed by German surgeons.

Bones and artificial teeth were removed in 62 per cent. of the cases. Von Cock of London was the first to remove a set of artificial teeth (in 1856). Since that time tooth-plates have composed 35 per cent. of all foreign bodies removed. Krönlein[3] of Zurich has done 6 operations with only 1 death.

Of the 135 cases, 100 recovered. The mortality is greatest when some time has elapsed after the impaction of the foreign body. Of operations performed in the first three days, 46 showed a mortality of 19.5 per cent.; 28 operations after the third day, a mortality of 32.1 per cent. The death-rate depends also upon the situation and nature of the foreign body. Pieces of bone cause a greater mortality than tooth-plates; coins the lowest—11.1 per cent. In 135 cases there have been 8 of fatal hemorrhage and 14 of fatal perforation and gangrene, with abscess of the mediastinum, lungs, deep cervical space, etc. The hemorrhage took place twice from the internal jugular,

[1] *Deut. Zeitschrift für Chir.*, vol. xxv. p. 565, p. 107. vol. xxvii. p. 273, and vol. xxix.
[2] *Beitrage zur klin. Chir.*, 1894, p. 143. [3] Cited by Egloff, *loc. cit.*

once from the carotid, once from the inferior thyroid, once from the thyroid vein, and once from the ascending cervical artery. Williams of Manchester reported a fatal case of hemorrhage from the aorta due to perforation by a chop-bone.

In external œsophagotomy the incision should be made along the anterior border of the left sterno-cleido-mastoid muscle from the level of the cricoid cartilage to the sterno-clavicular articulation. The common carotid artery must be drawn to the left with the muscle. The outer border of the sterno-thyroid muscle should next be exposed, and below it the rings of the trachea. Deep in the space between the sterno-thyroid and the carotid the left border of the œsophagus will be found projecting slightly to the left of the trachea. If the anterior belly of the omohyoid muscle impedes the dissection, it should be drawn to the left. As soon as the tracheal rings are fully exposed, the dissection should be carried carefully backward until the longitudinal fibres of the œsophagus are visible. The only structures likely to be wounded are the inferior thyroid artery and the recurrent laryngeal nerve. If care is taken to make the field bloodless by securing immediately each bleeding point, both can easily be seen and avoided. The œsophagus itself will be recognized, not only by its position behind the trachea, but by the direction and appearance of its longitudinal fibres. In case of doubt a probang passed into the œsophagus through the mouth will demonstrate beyond question the exact position of the tube. The presenting surface of the œsophagus having been secured by means of forceps or of ligatures, the incision should be made longitudinally, layer by layer, through muscular wall and mucous membrane. It is a good plan at this point to pass threads through the œsophageal wall at the upper and lower angle of the incision and halfway between. These threads, held by an assistant, will stretch the opening, so that a clear view of the interior may be obtained. This manœuvre will facilitate also the introduction of instruments. After the completion of the intraœsophageal manipulations the incision may be kept open by means of a tube, or it may be closed immediately by inverting the edges after the manner of an intestinal suture. Immediate closure is the ideal procedure, though possibly the more dangerous. In case the œsophageal opening is sutured, the external wound may be either closed or drained temporarily by means of gauze. Closure of the external wound has certain dangers from the unavoidable contamination by the septic œsophagus. Post[1] of Boston has sutured both wounds without drainage, with absolutely primary union.

After external œsophagotomy with immediate suture the patient should be nourished for a few days by rectal enemata. He may be fed immediately through the tube, if one is used. When both incisions are sutured, healing may take place by first intention, and the wound may be perfectly secure in from ten days to three weeks. The open wound requires from three weeks to three months.

MORBID GROWTHS OF THE ŒSOPHAGUS.—Benign tumors of the œsophagus are very rare, not over 40 cases in all having been reported. Most forms have no surgical or functional importance, and are not recognized during life. Males are affected more often than females. The varieties in the order of their frequency are as follows: Fibromata,

[1] *Bost. Med. and Surg. Journ.*, Dec., 1893.

myomata, and lipomata, cystomata or retention-cysts, warts or excrescences, and adenomata.

The form of benign growth most important from the surgical point of view is the fibrous polyp. This usually starts from the lower part of the pharynx and hangs down a greater or less distance into the œsophagus. The pedicle springs from the submucosa. Rokitansky's case, reported in 1840 and cited by Solis-Cohen, measured 7½ inches in length; the blunt end, which reached nearly to the cardia, was 2½ inches thick. Cheatem's case of fibro-myxomatous polyp measured 5 inches in length and 1 inch in diameter. Lipomata, myomata, and fibromata are occasionally seen. They are usually small, and seldom cause symptoms. Warts and papillary growths are quite frequently found in old persons. Cystomata are small retention-cysts of the mucous follicles.

Symptoms and Diagnosis.—Of the benign tumors affecting the œsophagus, only polypoid growths give rise to symptoms or need treatment. Dysphagia, vomiting, cough, dyspnœa, and pain in the throat have all been noted. Some of the largest polyps have caused no difficulty in swallowing. Sometimes they are regurgitated into the pharynx and interfere with breathing. In a few cases this accident has made a diagnosis possible; in most instances it has never been made. When dysphagia or other symptoms call attention to the œsophagus, exploration by means of sounds or with the œsophagoscope will reveal the presence of a polyp. A positive diagnosis cannot be made unless the tumor is seen when regurgitated, or unless it is demonstrated by means of the œsophagoscope. The tumor, still remaining pendent, gives no characteristic sensation to the passage of the probang. The œsophagoscope has been used successfully in one instance by Mackenzie.[1] Only the larger growths can be diagnosticated. When the existence of a pedunculated polyp is suspected attempts may be made, by means of a large bulbed probang or the bristle probang, to withdraw the dependent portion. Emetics may also be used to produce regurgitation. When such efforts are made everything should be in readiness to grasp and remove the tumor.

The **prognosis** is not unfavorable: the patient either lives a tolerable life in spite of the pressure of the mass and the dysphagia, or is entirely cured by removal of the growth.

Treatment.—A number of cases have been reported in which the tumor has been successfully diagnosticated and removed. In some cases regurgitation has been produced by emesis. If this method fails, œsophagotomy, or even gastrotomy, may be resorted to in special cases. By exploration with the œsophagoscope and other œsophageal instruments, the pedicle being generally high up, a tolerably accurate knowledge of its exact situation can be obtained. If the attachment can be seen or felt in the lower part of the pharynx, it may be divided by the electric loop or by the wire écraseur. The great safety with which external œsophagotomy can now be performed in non-suppurative cases makes the removal of pharyngeal and œsophageal tumors by this route preferable to blind attempts through the mouth. Even if the tumor is situated low down in the œsophagus, exploration through the stomach offers a by no means hopeless route of attack, especially in view of the great ease and comparatively slight risks of explorations from below.

[1] *Loc. cit.*

The *malignant growths* of the œsophagus are carcinoma and sarcoma. Sarcoma is so rare that only 5 or 6 cases have been recorded. Of these Solis-Cohen[1] found but 2. Zenker[2] gives only 1 case. Shaw[3] and Stephan[4] give 1 case each.

Carcinoma of the œsophagus is more frequent than any other œsophageal disease, though less common than cancer of the stomach. Tachon,[5] out of 9118 cases of cancer, found 2303 of cancer of the stomach, and only 13 of cancer of the œsophagus. Von Hacker,[6] out of a total of 41,366 cases in Billroth's clinic for the ten years preceding 1892, found 270 of œsophageal disease, and of these 131 were cancer. The form of cancer most commonly found is the squamous variety of epithelioma. Butlin,[7] out of 59 cases, found 54 of this kind: 3 were scirrhous, 1 medullary, and 1 colloid.

FIG. 162.

Cancer of œsophagus (Warren Museum).

Œsophageal cancer is usually situated near the cardia; less frequently in the cervical portion, though any part may be involved. Opinions differ, however, as to the usual seat of the disease. Zenker[8] found the majority in the lower third. Rebitzer[9] also in 29 autopsies of cancer of the œsophagus found the disease most frequent in the lower third. Very rarely the whole tube may be involved. Cancer of the œsophagus is generally primary, starting in the mucous membrane. It may be secondary, however, to cancer of the stomach, tongue, pharynx, larynx, or tonsils. In extension from the stomach the disease seldom goes far above the cardia.

Secondary manifestations of œsophageal cancer are—infection of the bronchial lymph-glands, of the mediastinal tissues, of the stomach and liver (left lobe), and of the trachea, bronchi, and lungs.

Ulceration may take place into the trachea and into the great vessels. The tissues in close relation with the œsophagus may become involved by direct growth. Occasionally there is pressure upon the recurrent laryngeal nerve on one or both sides.

Cancer of the œsophagus is much more frequent in males than in females. Butlin[10] in his 59 cases found 47 males; Zenker,[11] 11 males in 15 cases; Mackenzie,[12] 71 in 100. The disease most frequently occurs between the ages of forty and seventy; it is rare under thirty. The average age in Rebitzer's[13] series is fifty-eight years and a fraction

[1] *Loc. cit.* [2] *Loc. cit.* [3] *Brit. Med. Journ.*, Mar. 21, 1891.
[4] *Jahrbuch für Kinderheilkunde*, vol. xxx. p. 354.
[5] *Traite pratique des Maladies cancereuses*, Sec. 3, p. 442, Paris, 1851. [6] *Loc. cit.*
[7] *Sarcoma and Carcinoma*, London, 1882, p. 161. [8] *Von Ziemssen's Encyclopedia.*
[9] *Zur Kenntniss des Krebses der Speiserohre 1889 im Nuremburg*, monograph.
[10] *Loc. cit.* [11] *Loc. cit.* [12] *Loc. cit.* [13] *Loc. cit.*

(58.85). Solis-Cohen states that in men this disease is most frequent between the ages of forty-four and fifty-four; in women it occurs, on the average, ten years earlier.

Scar-tissue in the œsophagus, whether from burns, foreign bodies, or ulcers, is by degeneration probably the chief exciting cause of cancer. It is thought that any irritant which produces cell-proliferation may be an active cause, though the evidence is not positive (Fig. 162).

Symptoms and Diagnosis.—The first prominent symptoms of œsophageal cancer are caused by stricture. There is at first inability to swallow solids and semisolids. Later, everything except liquid food is regurgitated. The dysphagia is frequently accompanied by pain and œsophageal spasm. The history shows a loss of weight and strength, to which little attention has been paid. As the stenosis increases the insufficient supply of food makes the emaciation more rapid and the loss of strength more evident. That the extreme weakness and loss of weight are not due to the cancerous cachexia alone is shown by the rapid regaining of strength and flesh after gastrostomy. The subjective symptoms are often limited to dysphagia. Pain, though at times absent, may be a constant and serious symptom, requiring the frequent use of opiates. The tumor soon ulcerates, and may cause hemorrhage, yet hæmatemesis is infrequent at any stage of cancer. Toward the close of the disease, even after the establishment of a gastric fistula, the suffering may be very great. This is probably due to pressure of the tumor with infiltration into the surrounding parts.

The existence of malignant stricture, to which attention has been drawn by the subjective symptoms already described, can be easily demonstrated by the passage of a probang. Even with bulbs of medium size more or less obstruction will usually be encountered. Indeed, even if deglutition is tolerably efficient, it is not unusual to find the stricture impermeable to the smallest instruments. In such cases the opening is probably in the centre of a projecting and irregular mass by which the point of the instrument is turned aside. In other words, the opening is not funnel-shaped. The sound in passing the obstruction may give the sensation of considerable breadth or that of a narrow ring. The surface traversed may be irregular and nodulated, suggesting that of cancerous ulcerations elsewhere. Blood and bits of tissue may be withdrawn by the sound and examined by the microscope.

Diagnosis and **Treatment** of œsophageal cancer will be considered under Strictures of the Œsophagus.

STRICTURES OF THE ŒSOPHAGUS.—The most frequent pathological condition of the œsophagus is a narrowing of the tube to such an extent as to endanger life by interfering with nutrition; hence the most common surgical problem in connection with this portion of the alimentary canal is to make the passage of food into the stomach possible. In some cases the problem is easily solved; in others the surgeon's resources are taxed to the utmost.

Strictures of the œsophagus may be—(1) congenital; (2) spasmodic or spastic; (3) cicatricial; (4) the result of pressure from without; (5) cancerous.

Congenital strictures of the œsophagus, as already stated, are generally incompatible with life. Occasionally, though very rarely, such

conditions exist in adults. The earliest case is that reported by Gerard Blasius.[1] Zenker[2] refers to this case and 6 others. Brosset[3] could find only 7 cases in all literature up to 1889. Kendall Franks[4] in the report of a successful œsophagectomy for this condition mentions but 9 cases besides his own. One of Brosset's cases is omitted in this collection. The total number reported up to the present time is 14. Emil Mayer[5] reports a case of tight stricture, low down, in a girl of nine. These cases are simple annular narrowings of the tube, without pathological change in the walls. In the opinion of many men none of them are congenital. Crary[6] reports a case in a man twenty-one years old, and Grandon[7] adds another.

Spasmodic or Spastic Stricture.—Spasmodic contraction of the œsophagus, or œsophagismus, is a nervous affection. It may proceed from some irritation of the œsophagus or it may be purely a reflex nervous phenomenon. According to Zenker[8] and Ewald,[9] it may be caused by cerebral and spinal disease, by mental disturbance, by neuralgia, by pregnancy, by urinary disease, by intestinal worms, by neurasthenia, by hysteria, and by direct or by remote irritation, as œsophagitis, gastritis, and gastric cancer. The spasm is purely functional, and may involve the whole œsophagus so as to simulate hydrophobia (Barnes, referred to by Ewald). The disease is most common in hysterical women, and is seldom serious, though one fatal case has been reported, that of Power's.[10] The œsophageal spasm may follow the supposed lodgement of a foreign body.

The **diagnosis** of spasmodic stricture is usually easy, for the contractions are paroxysmal and intermittent. The obstruction can be overcome by firm pressure with a large sound. Under anæsthesia the stricture entirely disappears.

Cicatricial strictures are caused by the contraction of the scar-tissue which results from the healing of diseased surfaces in the œsophagus. The primary cause is injury to the mucous membrane from wounds, from escharotics, and from the impaction of foreign bodies. The accidental or intentional swallowing of lye, ammonia, and acids is the most common cause of cicatricial strictures of the œsophagus; next in frequency are foreign bodies long impacted; and finally, tubercular, syphilitic, and peptic ulcers. According to Ewald and Zenker,[11] peptic ulcers may very rarely cause cicatricial strictures. Syphilitic ulcers and gummata doubtless occur, but are very infrequent.

Cicatricial strictures are dense and unyielding, especially if they involve the muscular wall. They naturally tend to contract indefinitely, without ulceration. Their usual situation is in the beginning of the œsophagus either behind the cricoid cartilage or just above the cardia. Escharotics may affect the whole circumference of the tube, and may obliterate the lumen entirely, as in a case reported by the author.[12] However, in this case, that of a child, no definite history of the swallowing of an escharotic could be elicited. Deglutition became gradually

[1] *Observata Anatomica*, 1674, p. 120.
[2] *Loc. cit.*
[3] *Loc. cit.*
[4] *Brit. Med. Journ.*, Nov. 3, 1894.
[5] *Amer. Journ. Med. Sci.*, Nov., 1893.
[6] *New York Med. Journ.*, July 11, 1891.
[7] *Bull. de la Soc. Anat.*, Paris, 1891, p. 57.
[8] *Loc. cit.*
[9] *Klinik des Verdauungs-Krankheiten*, 1888 and 1892.
[10] *Lancet*, 1866, i. No. 10.
[11] *Loc. cit.*
[12] *Boston Medical and Surgical Journal*, January, 1892.

more and more difficult, until finally nothing whatever could be swallowed. Though external œsophagotomy was performed, it was impossible to find an opening through the stricture. At the autopsy the whole œsophageal canal was found obliterated. Zenker [1] reports a similar case, that of a child of three and a half, in whom there was complete cicatri-

FIG. 163.

Cicatricial stricture of œsophagus (Warren Museum).

FIG. 164.

A very tight stricture of the œsophagus of many years' duration, apparently the result of chronic inflammatory action; small abscess on the left (Warren Museum).

cial atresia of the whole œsophagus. Death from septic mediastinitis followed the operation (Figs. 163 and 164).

Œsophageal strictures may result from the compression of tubercular or malignant bronchial glands, from disease or tumors of the mediastinum, from disease or tumors of the vertebræ, from enlargement of the thyroid gland, from aortic aneurysm, and from œsophageal diverticula, the last sometimes containing foreign bodies.

Ziemssen and Zenker [2] describe a case of marked compression of the œsophagus by a goitre. A case was recently operated upon by myself at the Massachusetts General Hospital in which the œsophagus and trachea were firmly encircled and compressed by malignant disease of the left lobe of the thyroid. Death followed from exhaustion after the removal of the greater portion of the tumor. Mixter has removed a retro-œsophageal myxo-sarcoma in front of which both œsophagus and trachea were so flattened as to interfere with deglutition and respiration.

The right subclavian artery is given off occasionally from the descending portion of the arch of the aorta, crossing the œsophagus

[1] *Loc. cit.* [2] *Loc. cit.*

at an oblique angle. This anomaly has been regarded by some authorities, especially Autenreith, as a possible cause of obscure symptoms of stenosis. This assertion is without proof and is probably fallacious (Zenker).

The possible existence of an aneurysm pressing upon the œsophagus must be borne in mind in the passage of sounds for œsophageal obstruction. Several cases are mentioned in which the instrument caused fatal perforation.

Malignant Stricture.—Cancerous strictures of the œsophagus are more frequent than all other kinds together. They may be situated in any part of the tube, but most commonly in the lower third. (See Cancer of the Œsophagus and Von Hacker's statistics, p. 237.) Cancer of the cardiac extremity of the stomach, involving the œsophagus, probably starts in the œsophagus and extends downward. Some authorities[1] speak of cancer limited strictly to the cardia. In cancerous strictures an annular or an extensively infiltrating tumor diminishes by its bulk the calibre of the tube. At the same time the distensibility of the œsophagus is impaired. The calibre may be so diminished before ulceration ensues that it will not admit the tip of the finger. In advanced cases the stenosis may be practically complete, admitting only a probe. As the result of ulceration the size of the opening may become abnormally large. The lumen of the œsophagus may be obliterated by a large irregular mass through which only a narrow and devious passage remains. Dilatation above the mass may exist to a greater or less degree, with folds or pouches in which the sound is easily caught. In such cases the passage of instruments, except by chance, is impossible. In other instances a gradual narrowing guides the sound directly into the contracted lumen.

In the course of the disease the œsophagus may be drawn to one side by cicatricial contraction, so that the lumen is not in the centre of the tumor. From the great variation in the size, shape, and situation of the growth, and from the differing conditions of dilatation, hypertrophy, and sacculation, many cases present insuperable obstacles to the passage of sounds; others none whatever.

For a short distance above the stricture there is generally an hypertrophy of the circular muscular layer. Rarely this may involve the whole length of the tube. Below the stricture the œsophagus is normal. There may be sacculation, with lodgement of food, but diverticula are very rare.

Symptoms of Œsophageal Stenosis.—The first and most important symptom is interference with deglutition. Gradually increasing dysphagia is usually caused by malignant disease or by slow contraction of cicatrices. Difficulty in swallowing may come on quickly from wounds and escharotics as the immediate result of such injuries. The dysphagia of permanent organic stenosis develops slowly. When the obstruction is so great that the patient suffers from insufficient food, the signs of malnutrition appear. In non-malignant cases these symptoms are due entirely to starvation; in cancer they are partly dependent upon a constitutional cachexia. Pain in some form is usually present, but is not often severe.

[1] Brinton, *Lectures on Diseases of the Stomach*, London, 1864, p. 227; Ewald, *loc. cit.*; Hanot, *Archiv. générale de Méd.*, Oct., 1881.

In cancer the pain is described as dull and boring, though occasionally it is so sharp and distressing as to require opiates. The pain is not affected by swallowing. Rarely there may be dyspnœa from an accumulation of food in the œsophagus or from spasm of the glottis.

Diagnosis.—The diagnosis of œsophageal obstruction is easy. It depends first upon the subjective symptoms, as already given, which call attention to the œsophagus. Exploration with the sound makes the diagnosis positive, unless, for the reasons already stated, the sound gets caught in a pouch in the pharynx. If the sound, once having entered the œsophagus, meets with a resistance which gentle pressure does not overcome, an organic stenosis is demonstrated. Though further investigation is in most cases unnecessary, auscultation of the œsophagus may be practised. By this means the normal sounds of deglutition may or may not be noted.

For the intelligent treatment of œsophageal obstruction it is essential to know its exact nature, seat, and cause; hence the differential diagnosis is of great importance. The diagnosis of cicatricial strictures depends largely upon the history, which, except from infants and from the insane, can usually be obtained. As in cancer, simple cicatricial stenoses come on gradually, though in the very beginning there may be a sudden temporary dysphagia. Stenosis caused by a foreign body develops after the dislodgement of the body and the healing of the ulceration. Long-continued impaction, however, does not necessarily cause stricture. Simple strictures cannot be differentiated from malignant by the gradual onset of the stenosis. Malnutrition does not develop as rapidly, nor is it as marked, in cicatricial stricture as it is in cancer. In cicatricial strictures, which may occur at any age, the sound meets with a resistance, gradual or sudden, in which there is no sensation of roughness or irregularity. As the point gets engaged in the stricture a sudden firm resistance is encountered under moderate pressure. The probang either does not pass at all or it goes by suddenly, the resistance vanishing in a moment. In withdrawing the instrument the same sensations are encountered. Unless great force is used or unless the ulcerating surface is incompletely healed, there will be neither blood nor shreds upon the probang. Dilatation by means of the probang is productive of great relief of dysphagia, a relief which, though temporary, may last some days or weeks. Though this is true in cancerous strictures also, the benefit is much less marked and less lasting. If the material regurgitated comes from a dilatation of the œsophagus, it will not contain gastric juice, bile, or acid. It will be neutral or alkaline, and will not digest albumin.[1]

Cancerous strictures are rarely if ever seen before adult life. The general marasmus is marked, due to malnutrition and to malignant cachexia. In cancer the sound either encounters an insuperable resistance or it passes over an irregular friable surface. The resistance may disappear suddenly or gradually. Withdrawal is accompanied by similar sensations; moreover, blood and shreds of tissue are usually found upon the bulb. In the early stage of cancer of the œsophagus symptoms caused by periœsophageal infiltration or pressure are not present; in this stage, too, ulceration does not exist. It is therefore more difficult at this time than later to differentiate cancer from other causes

[1] Ewald, *Klinik der Verdauungs-Krankheiten.*

of stricture, for the passage of the sound will not be attended by characteristic sensations. It is in precisely this stage, however, that the diagnosis is important; hence much reliance must be placed upon the history and upon the age of the patient. In the later stages of cancer the diagnosis can be made out with great accuracy, for, in addition to the symptoms already given, we have those of ulceration, extension, and cachexia. When high up the disease may cause hoarseness by involving the recurrent laryngeal nerve. This symptom, especially if it comes on gradually, aids not only in determining the nature of the disease, but also in localizing it. A cancer extensive enough to involve these nerves could be felt if above the clavicle; hence in the absence of a cervical tumor, when there is hoarseness or dyspnœa from this cause, the disease is probably situated either between the arch of the aorta and the interclavicular notch on the left side, or on the right side in the immediate vicinity of the beginning of the subclavian artery.

The diagnosis of cancer, finally, may be confirmed by the use of the œsophagoscope. The diagnosis is usually so clear, however, that this troublesome instrument is not essential. The differential diagnosis between strictures and diverticula has already been discussed. (See Diverticula, page 219.)

It is sometimes difficult to eliminate the existence of tumors pressing upon the œsophagus and giving rise to stenosis. The absence of thyroid tumors should first be demonstrated. These occasionally give rise to extreme dysphagia, but usually involve also the trachea and produce dyspnœa. The recurrent nerves may likewise be affected by them. Paralysis of the posterior crico-arytenoid muscle from this cause, with the mechanical pressure of the tumor, may produce alarming symptoms of suffocation. Thoracic aneurysm pressing upon the œsophagus may be eliminated by the absence of its characteristic signs. One can usually detect circumscribed tumors in the neck pressing on the œsophagus, especially if at the same time they interfere with breathing. In Mixter's case, already referred to, a retro-œsophageal myxo-sarcoma in the neck, causing dysphagia and dyspnœa, was found, although neither its outlines nor its situation could be demonstrated before operation. If, therefore, we can at times only with difficulty diagnosticate cervical tumors, we cannot more than suspect the existence of mediastinal growths. Occasionally such tumors may closely resemble cancerous strictures, for they may not only press upon the œsophagus, but they may involve directly its walls, and thus give rise to the characteristic physical obstruction to the passage of the probang. Moreover, if malignant, they may cause the same general cachexia. In instrumental explorations for diagnosis we cannot too often repeat our caution as to the careful use of probangs in cases of stenosis, especially when the narrowing of the tube is caused by pressure from without; for we may not only do irreparable damage to the œsophagus itself, but by too great force may perforate an aneurysm or involve by a false passage some thoracic viscus.

The diagnosis of spastic strictures is generally easy. If the probang meets an obstruction at one time and not at another, organic stenosis cannot be present. In such cases gentle and prolonged pressure with a large probang, by causing the stenosis to give way, will demonstrate its spasmodic nature.

Instrumental exploration of the œsophagus for the detection of stricture is a surgical operation in itself, and should be performed with the greatest care. The instruments used for this purpose are the olive-tipped probang, the sponge probang, rubber or catgut bougies, and more or less flexible hollow tubes. Mixter uses a whalebone with a rubber bougie guide. The common whalebone or metallic guide, tipped with ivory or with hard rubber, makes the most useful exploring instrument. The bulbs should be of all sizes, from that of a bean to that of an olive. A stiff sound is dangerous unless the point is flexible. Even then the flexible point may be bent upon itself, making a practically unyielding extremity. A hollow tube that can be filled with water may be used. Sponge probangs and sounds with blunt points to guide them have the advantage of bringing up shreds of tissue for microscopic examination. For practical use the instruments already described are all that are necessary. When stricture is suspected a large olive-tipped probang should first be used. This will indicate the exact seat of the lesion, and will usually be brought up firmly against it without passing. If with very gentle efforts this probang does not pass, smaller ones should be used, the gentleness of the manipulation increasing with the diminished diameter. Finally, if necessary, the fine bougie-tipped whalebone guides of Mixter may be used (Fig. 165). If none but the gentlest efforts are employed for these investigations, little danger is to be apprehended.

The **prognosis** in spasmodic and in simple congenital stricture is good. The prognosis is good also in cicatricial strictures if they can be dilated enough for nutrition to be successfully maintained. If the œsophagus is practically obliterated in more or less of its course, the patient's future depends upon operations in themselves hazardous. If there is extensive dilatation above a firmly-contracted cicatricial stricture, the prognosis is serious. Malignant strictures are almost invariably fatal, in spite of the radical operation occasionally attempted. Compression strictures are usually fatal in the course of the primary disease.

Treatment of Stricture of the Œsophagus.—Simple congenital strictures are usually treated by dilatation at intervals. If the stricture is suitably located, œsophagectomy may be performed. (See Operations on the Œsophagus.) This operation has been done by Kendall Franks[1] once successfully for simple stricture in a woman of forty-six. The ends of the œsophagus after excision of a simple annular stricture were sutured over a permanent tube passed through the nose.

The treatment of spasmodic strictures should be directed first to the constitutional causes which predispose the patient to them. The only surgical treatment is the occasional passage of large sounds.

Cicatricial strictures demand mechanical dilatation, to be repeated from time to time as long as the patient lives. For this purpose ivory-tipped probangs, bougies of rubber or catgut, Trousseau's graduated sound, and the soft-rubber tube of Ewald may be used. Sounds must not be used too frequently or with too much force, for fear of causing mechanical injury and inflammation.[2] A hypodermic injection of morphia and atropia before the use of the sound is recommended by Ewald to stop the flow of saliva and to relax the spasm, which, from attendant irritation, often increases the already existing stenosis. The use of the sound must

[1] *Loc. cit.* [2] Mackenzie, *loc. cit.*

be persisted in, for the stricture tends to contract. The employment of sounds in very tight strictures is of questionable benefit.

Very little can be said in favor of the use of electrolysis in this form of stenosis. It is at best of doubtful efficacy, and, moreover, is said to be attended by considerable danger from stimulation of the pneumogastrics. The results in Kendall Frank's 4 cases treated in this manner show no advantage over simple dilatation. Electrolysis combined with mechanical dilatation has been successfully employed by Bœckel[1] and by Lacaille.[2] For simple dilatation many instruments have been devised. Some are too complicated for use; others cannot be employed without great danger of perforation. Fletcher's divulsor is a sound with tapering blades which are separated by pulling up a ball on the inside. Laminaria plugs, introduced with a guide and left in the stricture, are dangerous and hard to remove. Trousseau's sound, already mentioned, is often useful. Jameson's instrument, invented in 1825, leaves in the stricture a solid dilator which is removed by a thread through the mouth. Von Bruns used an instrument with a sliding dilator to be pulled up by a string. Hollow tubes into which air, water, or mercury may be forced have been employed. The latest instrument of this sort is that of Schreiber.[3] This is a sound combined with a rubber tube, the latter being introduced into the stricture and filled with water. No statistics of its use are given. The advantages of these complicated instruments are questionable. In strictures here, as in other parts of the body, the simplest means for dilatation are usually the best. Permanent tubage by Symonds' or by Mixter's method may be used in those cases in which dilatation is impossible. (See Treatment of Cancerous Stricture.)

For œsophagotomy, œsophagostomy, œsophagectomy, gastrostomy, and retrograde dilatation see Operations on the Œsophagus.

Treatment of Cancerous Stricture.—Except in rare instances the surgical treatment of cancerous stricture of the œsophagus is wholly palliative. To lessen suffering and to prolong life are the chief objects of interference. The cautious use of sounds at regular intervals is, in the great majority of cases, an effective palliative measure. The chief objection to this method is the danger of perforation. If gentle manipulations do not succeed in maintaining a free passage to the stomach, œsophagostomy, permanent tubage, or gastrostomy must be performed. Œsophagostomy is applicable to those cases only in which the obstruction is high up. It should be performed before the patient's strength is greatly reduced. In some respects this method is preferable to gastrostomy, though the latter is, on the whole, a safer operation and better adapted to artificial feeding. (For the technique of œsophagostomy see Operations on the Œsophagus.)

By permanent tubage the discomforts and dangers of both gastrostomy and œsophagostomy are avoided. When this method can be used with facility it is preferable to any other. The idea was first suggested by Switzer of Copenhagen in 1843. In the beginning a tube was used which reached the whole length of the œsophagus. Mackenzie in 1883 devised a short tube which was introduced into the stricture by means of a guide. Symonds in the following year substituted a short gum-

[1] *Gaz. méd. Strasburg*, August 1, 1892.
[2] *Berlin. klin. Woch.*, 1893, No. 32.
[3] *Journ. méd. Paris*, March 5, 1893.

elastic catheter with a funnel-shaped upper extremity. The tube is long enough to pass through the whole constriction and to project below. The instrument is introduced by means of a guide, as described by Symonds.[1] The tube should be removed every ten or twelve days, and after an interval of a few hours another substituted. Removal is accomplished by means of a thread attached to the upper extremity of the tube and projecting from the mouth. The chief mechanical disadvantages in the use of these tubes are that they may become clogged or get impacted. In the former case the tube must be removed, cleansed, and reintroduced; in the latter it must be treated as an impacted foreign body.

FIG. 165.

Symonds' tube, with Mixter's guide.

Mixter[2] has reported a modification of Symonds' method (Fig. 165). The same idea has been carried out by Gersung,[3] who used a long permanent tube.

Authorities differ as to the value of permanent tubage, the chief objection being that it causes irritation, ulceration, and rapid increase in the growth of the tumor; on the other hand, Symonds, Mixter, and others have used it with great success. Mixter has reported four cases which lived longer and suffered less than cases treated by him in any other way. The method is a valuable one when the tube can be worn without discomfort, for it makes gastrostomy unnecessary. By its use further contraction of the stricture is prevented. Some surgeons who oppose the use of tubes in cancerous strictures recommend them in cicatricial, but cicatricial strictures which admit an ordinary-sized tube can be treated more safely and more effectively by repeated dilatations with the probang. If the tube can be introduced readily, the use of permanent tubage in strictures low down seems, as already stated, of great efficacy, for the easy passage of food is ensured, the ulcerated surface is

[1] *Lancet*, March 30, 1889.
[2] *Boston Medical and Surgical Journal*, Oct., 1890, and Jan., 1891.
[3] *Wiener med. Woch.*, 1887, No. 43.

protected, and the discomforts of an open wound in the stomach or œsophagus are avoided.

Gastrotomy with retrograde dilatation, by whatever method, is of doubtful efficacy in malignant strictures. So serious an operation is hardly justifiable, considering the rapidity with which malignant obstructions recur after temporary dilatation. (See Gastrotomy under Operations upon the Stomach.)

Gastrostomy is the operation of choice in impermeable cancerous strictures. It should be performed, if possible, before the patient shows signs of starvation. The operation is indicated, therefore, when dilatation is unsatisfactory or when other less hazardous methods fail. (See Operations on the Stomach.)

Radical removal of the growth may be attempted in those very rare instances in which the disease is accessible and confined within narrow limits to the œsophagus itself. (See Œsophagectomy under Operations upon the Œsophagus.)

In compression-strictures the treatment must be directed to the primary cause. Thyroid and other cervical tumors should be removed if possible. By the use of sounds pressure can be relieved only temporarily. In some cases the patient may be fed through an œsophageal tube. If this is impossible, gastrostomy or œsophagostomy must be performed.

Operations for Diseases of the Œsophagus.—The operations which are performed upon the œsophagus for various abnormal conditions are external œsophagotomy, internal œsophagotomy, combined œsophagotomy, œsophagostomy, œsophagectomy, and retrograde dilatation after gastrotomy.

External œsophagotomy has been fully described under the head of Foreign Bodies and their Removal. *Internal œsophagotomy* is performed on the principle of internal urethrotomy. The operation, first introduced in 1861 by Maisonneuve[1] with 2 recoveries in 3 cases, has been studied and performed by various surgeons—Lannelongue, Trelat, and Tillaux in France; Schilz and Czerny in Germany; and Mackenzie in England. The principle of the œsophagotome is that of a guarded cutting blade, either single or double, by which the tissues of the stricture are divided. The chief objection to the use of this instrument lies in the intimate relation between the œsophagus and organs so essential to life that a slight wound to them would be fatal. The aorta, or even the heart itself, may be involved. Even if the cut can be made successfully in cicatricial strictures, to which this method is especially adapted, permanent relief will be secured only by the repeated use of sounds, for recurrence of the stenosis is practically sure to follow. This treatment may be used with comparatively little danger in cicatricial annular strictures above the aortic arch. Below this point the contiguous structures are so important that the operation should never be considered. König[2] condemns the method as dangerous. The operation has been performed about twenty-five times. Ashhurst[3] gives 20 cases, with 5 deaths. Coccherelli[4] advises the operation in certain cases, and has performed it with success.

[1] *Clinique chirurgicale*, t. ii. p. 409, 1864.
[2] *Deutsche Chirurgie*, loc. cit.
[3] *Loc. cit.*
[4] *Berlin. klin. Woch.*, April 23, 1894.

In *combined œsophagotomy* the œsophagus is opened by external incision, through which the stricture is divided. Gussenbauer[1] performed the first operation in 1883 and gave the operation its name. Various instruments have been used for the purpose—herniotomes, tenotomes, etc.—with or without grooved directors. The operation is indicated only in strictures high enough to be reached by the external incision. It can be applied, therefore, to any stricture above the arch of the aorta. This method has the advantage over the internal operation that the instruments can be intelligently directed and important structures avoided. The combined operation has the great advantage of enabling the operator to ascertain the exact situation, shape, and size of the constriction. If radical extirpation of the stricture by œsophagectomy is possible, that operation may be performed at once.

In *œsophagostomy* the œsophagus is exposed as in external œsophagotomy. The walls of the tube may be sutured directly to the wound after simple incision. If lax enough, the œsophagus may be divided transversely and the distal end stitched to the skin after complete closure of the proximal. The operation has been done by Czerny, Nicoledoni, Mixter, and others. Ashhurst tabulated 36 cases with 27 deaths.[2] After the completion of the operation the patient is fed by means of a tube in the œsophageal wound, a permanent tube having been introduced. When the fistula has become fully established the tube can be introduced from time to time for purposes of nourishment.

Œsophagectomy has been performed for both malignant and benign strictures. Billroth[3] in 1870 first demonstrated upon dogs the possibility of the operation. Czerny[4] performed it successfully for cancer in an old woman. The growth recurred in a year. Von Bergmann in 1883 had a fatal case. Novarro[5] removed $2\frac{4}{5}$ inches of the œsophagus successfully and closed the fistula by a subsequent operation. Ashhurst refers to 12 cases with 8 deaths. A successful operation for simple congenital stricture was reported by Kendall Franks.[6] After excising the stricture he sutured the œsophagus over a catheter and closed the wound in the neck. He maintains that this is the only case of œsophagectomy for simple stricture. Franks and Butlin each collected 6 cases of œsophagectomy for cancer. König, Nasiloff, and Coccherelli advise this operation in all cases of malignant annular stricture within reach if no metastasis has taken place. The operation should be attempted in those cases only in which the disease is within reach by the external incision. It having been demonstrated by careful dissection and examination that the tumor, from its situation, from its size, and from the absence of surrounding infiltration, is suitable for extirpation, the œsophagus is divided transversely above and below the disease. If the walls are relaxed enough to permit easy approximation, restoration of the lumen is accomplished by uniting the inverted edges after the manner of intestinal suture. This may be done upon a catheter, as in Franks' case, or without mechanical aids. Provision against extravasation may be made either by leaving the external wound entirely open, or by suturing the cervical cut, a small strand

[1] *Zeitschrift f. Heilkunde*, March 20, 1883, and *Deut. med. Woch.*, Oct. 24, 1883.
[2] Solis-Cohen, *loc. cit.*
[3] *Langebeck's Archives*, vol. xiii. p. 65.
[4] *Centralblatt für Chir.*, 1877, p. 433.
[5] *Med. News*, 1884, p. 98.
[6] *Brit. Med. Journ.*, Nov. 3, 1894.

of gauze being left at the lower angle for drainage. The patient should be fed for two or three days through a stomach-tube or by rectal enemata. If too much of the œsophagus has been excised to permit easy approximation, the operation must be completed as in œsophagostomy.

Retrograde dilatation of the œsophagus is applicable especially to cicatricial contractions which cannot be successfully treated through the mouth. It consists in dilatation or divulsion from below after gastrotomy. The operation is said to have been suggested first by Schede. The œsophagus is explored through the stomach by means of bougies, divulsors, cutting instruments, or by the finger. The operation, sometimes called Loreta's, was first performed by this surgeon in 1883, and in the same year by Von Bergmann. From Loreta's first case (in 1883) to 1894 there have been 21 cases of retrograde dilatation, including Abbe's[1] first case by his string method. Franks[2] collected 21 cases, including 1 of his own. Of these cases 19 recovered. In 2 cases permanent gastric fistula has followed this procedure; in 2 no result is given. In retrograde operations upon the œsophagus the anterior surface of the stomach is first delivered through a small incision in the linea alba between the ensiform cartilage and the umbilicus. A transverse incision large enough to admit the instrument or the finger is then made near the lesser curvature of the stomach two or three inches above the pylorus. By traction upon the stomach, with the thumb and fingers of the left hand applied just below the incision, the lesser curvature is made into a sulcus, along which the instrument is easily guided directly

FIG. 166.

Author's method of passing an instrument into the œsophagus (from a photograph).

into the œsophagus (Fig. 166). The usual instruments may be used for dilatation after the stomach has been opened—bougies, probangs, dilators, and œsophagotomes. The stricture may be so shaped that dilatation can be accomplished from below when it cannot from above. If repeated dilatations are necessary by this route, a permanent gastric fistula must be made; but in this event the technique of introducing the instrument already described will be impossible, for the lesser curvature cannot be put upon the stretch. The difficulties of introducing instruments into the œsophagus unaided by the device suggested above may be very great or even insurmountable; for the cardiac opening can then be found only

[1] *Med. Record*, Feb. 15, 1893. [2] *Annals of Surgery*, 1894.

by groping about until it is stumbled upon accidentally. If the stricture admits only a very small instrument, a bougie passed up into the mouth may be followed by larger instruments. In Abbe's[1] valuable method of retrograde dilatation a piece of heavy braided silk is drawn up through the stricture by means of a small bougie guided into the œsophagus by the finger. The stricture is next put upon the stretch by the conical end of a larger bougie. By a sawing motion of the string the firm tissues of the stricture are cut until the bougie passes entirely through. Larger and larger bougies are used until the obstruction is entirely overcome. The yielding tissues contiguous to the stricture cannot be injured by the sawing motion of the string. After full dilatation a rubber tube corresponding in size to the largest bougie is drawn up past the point of stricture, the lower end projecting from the stomach-wound. This tube is left in two or three days. Dilatation is accomplished through the mouth after the fourth day. Murray and Lange[2] have treated cases successfully in this manner.

The first digital exploration of the œsophagus for the removal of an impacted foreign body was performed in 1886 by the writer.[3] The stomach, exposed by an incision parallel to the costal margin on the left side, was opened by a longitudinal cut halfway between the two curvatures and long enough to admit the hand. The tooth-plate, which for eleven months had been impacted near the cardia, was easily felt and removed. Convalescence was retarded by a septic pleurisy. The man remains well to this day. This operation has been successfully repeated by Bull of New York and Phinney of Baltimore. Wallace[4] reports a fourth case in which a tooth-plate was successfully removed from the lower end of the œsophagus, extraction by external œsophagotomy having failed. A fifth case, unsuccessful, is reported by Morton of Bristol, England.[5]

Digital exploration of the œsophagus requires a cut in both the abdominal and the gastric wall long enough to admit the hand. The incision through the stomach-wall and the subsequent manipulations can be made, as a rule, outside the peritoneal cavity by drawing the stomach out of the abdominal wound.

Retrograde digital dilatation of œsophageal strictures, necessarily limited to a single attempt, seems hardly justifiable in view of the dangers of the procedure—in cancerous strictures because dilatation is at best unsatisfactory, and in cicatricial because, even if it is complete, its effects are but transitory. As a preliminary step to other operations upon the œsophagus digital exploration may be indispensable.

Surgery of the Stomach.

Congenital malformations of the stomach are very rare, but cases occasionally occur in which surgical interference is necessary. Congenital displacement of the stomach is found in cases of lateral transposition of the viscera (situs transversus), in fissure of the abdomen and thorax, and in congenital deficiencies of the diaphragm. In infants not otherwise malformed the stomach may be found to be abnormally small.

[1] *Loc. cit.* [2] *Annals of Surgery*, Dec., 1894.
[3] *Boston Medical and Surgical Journal*, Dec. 16, 1886.
[4] *The Lancet*, p. 734, March 24, 1894. [5] *Annals of Surgery*, April, 1896, p. 415.

Complete atresia of the pylorus is extremely rare; pyloric stenosis, with or without hypertrophy of the entire stomach-wall, is more common. Thomson[1] reports the death on the twenty-sixth day after birth of an infant from uncontrollable vomiting, the cause of which was stenosis of the pylorus with enormous hypertrophy of the muscular coats. Pitt[2] has reported a similar case. The so-called hour-glass constriction of the stomach in a certain small proportion of cases is probably of congenital origin (Fig. 167). Hudson[3] collected 20 such cases, in 9 of which no adhesion or sign of ulcer could be found, and in which he contended that the cause was an anomaly of development.

FIG. 167.

Hour-glass contraction of stomach (Warren Museum, Harvard Medical School).

CONTUSION AND RUPTURE OF THE STOMACH.—(For perforating and penetrating gunshot wounds and stabs of the stomach see section on Penetrating Wounds of the Abdomen.)

Ruptures of the stomach, rare from any cause, are most frequently due to blows upon the epigastrium when the stomach is full. Rupture of the stomach may be caused also by violent contraction of its walls in vomiting, especially if from any constitutional or local disease a limited softening exists. The stomach is much less frequently ruptured than the intestines, not only because the former is protected by the margin of the ribs, but because its walls are thicker. Usually in cases of rupture other viscera are severely injured, and the accident is generally fatal. When complete rupture occurs extravasation of gastric contents may take place and cause general peritonitis. The latter does not invariably result unless the amount of material extravasated is excessive, for when the stomach is empty or the escape slow adhesions usually form quickly enough to limit the infection. Localized peritonitis following contusions or lacerations, without complete rupture of the stomach-wall, may result in painful adhesions to neighboring parts. Sometimes the damage to the gastric wall may be sufficient to cause necrosis and ulceration. As a remote result of these injuries gastric fistula may ensue.

[1] *Brit. Med. Journ.*, Sept. 21, 1895.
[2] *Trans. London Path. Soc.*, 1892, p. 63.
[3] *Ibid.*, 1887, vol. xxxviii. p. 133.

The seat of the rupture is generally near the pylorus or in the greater curvature of the stomach, though it may occur in any portion. In a case reported by Morris[1] there was a tear one and a quarter inches long in the middle of the greater curvature. In a case reported by Gannett[2] an extensive vertical tear divided the stomach almost completely. O'Farrell[3] reports a case in which violent vomiting during some febrile affection caused a rupture of the posterior wall three inches in length. Elliot recently (July, 1895) found a linear tear in the anterior stomach-wall, with rupture of the duodenum, caused by the kick of a horse. Both wounds were sutured, and, though death resulted, no evidence of peritonitis was found at autopsy.

The **symptoms** of rupture of the stomach are those of a local or of a general peritonitis. If the rupture occurs when the stomach is full, the signs of a general peritonitis will rapidly ensue. It does not follow, however, that the extravasation will be extensive or the peritonitis general even when the perforation involves a full stomach, for both depend somewhat upon the location of the tear. When it is in the anterior wall, the gastric contents may escape directly into the general peritoneal cavity, nothing except gravitation hindering this when the patient is recumbent. An extravasation from a rupture in the posterior wall will infect only the lesser omental cavity. In the former case the peritonitis will be general; in the latter, localized, with abscess-formation. In either case the extravasation may be spontaneously controlled by eversion of the gastric mucous membrane.

Diagnosis.—Contusion or laceration of the stomach-wall is attended by pain, vomiting, and shock. The pain is sharp and severe or dull and heavy. Vomiting is usually present, with or without blood. Hæmatemesis following a blow on the epigastrium is strongly indicative of injury to the stomach. The shock may be mild or severe; in some cases it is out of all proportion to the force of the blow. When extravasation has taken place the symptoms of rupture are associated with those of a local or of a general peritonitis.

The **treatment** of this extremely dangerous accident is obvious. The abdomen should be opened immediately and explored thoroughly. A tear in the stomach should be sutured by the interrupted or the continuous Lembert stitch or by any of the accepted methods of intestinal suture. In some instances the laceration is such that suturing is impracticable. The wound should then be packed with gauze in such a manner as to protect the peritoneal cavity from further infection. In limited extravasations general peritoneal irrigation is not necessary; indeed, it may do harm, for the solutions that are safe to use in the abdominal cavity are not germicidal, and may transfer colonies of micro-organisms to remote regions. In general infections there is no objection to extensive irrigation; in fact, this gives the patient the best chance of recovery. Gauze drainage should be used for a few days in all septic cases; in aseptic ones the abdominal wound may be closed. In contusions without severe symptoms great care must be taken in the palliative treatment, for the lesion may be such that necrosis and extravasation will be delayed several days. The chief points in the treatment of such cases

[1] *Ashhurst's Encyclopedia*, vol. v. p. 69.
[2] *Warren Museum of the Harvard Medical School.*
[3] *Lancet*, May 19, 1894.

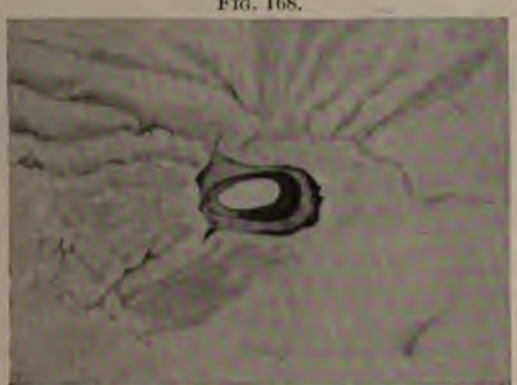
are—rest in bed, sedatives, local application of heat, cold, or counter-irritants, with rectal feeding.

The **prognosis**, depending upon the extent of the infection rather than upon the size and situation of the tear, can be given only after thorough exploration and repair. It varies with the promptness of interference, the complication of other viscera, and the amount of peritonitis.

Perforations of the stomach occurring in the course of disease may cause symptoms which demand immediate interference. The surgery of the stomach deals largely with such accidents. Perforation may occur in ulcer and in cancer of the stomach, and in dilatation with softening. It may be the result either of the extension of disease from neighboring organs or of the action of corrosive poisons. In the treatment of all forms of perforation of the stomach the material extravasated must be removed and further escape checked. (For the details of operative treatment see Treatment of Ulcer, Cancer, etc.)

Ulcer of the Stomach.—From the surgical point of view the round ulcer is one of the most important lesions of the stomach, not

Fig. 168.



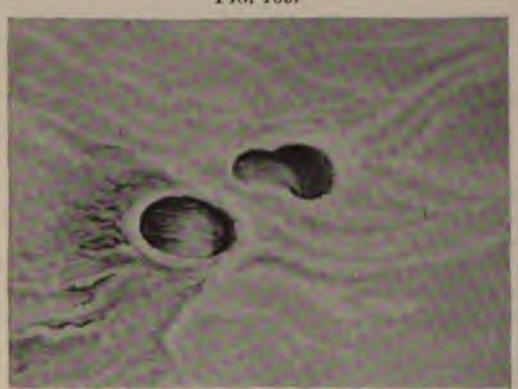
Perforating ulcer of the stomach (Warren Museum).

only because perforation and hemorrhage may take place in the progress of the ulcer, but because of the serious digestive disturbances which may result from cicatrizations, contractions, and other remote pathological changes. Ulcer of the stomach is caused directly by a circumscribed necrosis, which itself is probably dependent upon a diminished blood-supply. Many ulcers correspond directly to the distribution of a terminal artery. Whatever the cause, digestion immediately removes the necrotic tissue. Gastric ulcers have the shape of a cone with its base toward the interior of the stomach. The sharp edges of the ulcer give it a characteristic "punched-out" appearance (Figs. 168, 169, 170).

This disease occurs most frequently in women between the ages of twenty and forty; it is found less often in men. The ulcers vary in size from that of a five-cent piece (2.1 cm.) to that of a quarter (2.5 cm.), rarely being larger. Ulcers of the stomach are usually single. Welch in an analysis of 793 cases found 33.6 per cent. on the lesser curvature, 29.6 per cent. on the posterior wall, 12 per cent. at the pylorus, and 8 per cent. on the anterior wall.

The predisposing causes of gastric ulcer are alcoholism, anæmia, trauma, violent vomiting, vascular spasm, hyperacidity of the gastric juice, circumscribed stasis or infarcts, amyloid or atheromatous degeneration. The connection between these conditions and the ulceration is not always easy to understand. Ulcer of the stomach, as well as ulcer of the duodenum, has been observed in connection with extensive burns of the skin, especially in children. In some patients embolism may account rationally for the formation of ulcers. Their appearance in others, especially in patients who are well nourished and vigorous, is hard to explain. Leith,[1] after reporting 50 autopsies for ulcer of the stomach, came to the conclusion that a lessened blood-supply to circumscribed areas is the most frequent cause. With reference to trauma, it is easy to see how blows violent enough to produce laceration and rupture may result in necrosis. Vanni[2] collected 15 such cases; Duplay,[3] 3.

FIG. 169.



Two ulcers in the small curvature of the stomach, base formed by muscular coat (Warren Museum).

FIG. 170.

An ulcer of the stomach, showing at its base the open orifice of a vessel; death from hemorrhage (Warren Museum).

Studies as to the bacteriological origin of ulcers throw little light upon the etiology. Letulle[4] produced ulcers of the stomach in guinea-pigs by the injection of streptococci found in ulcers of the human stomach. Ewald and Gillespie found twenty-four kinds of bacteria in the stomach, the most important being the bacillus coli communis. The influence of these micro-organisms as a cause of gastric ulcer is not understood. It has been suggested by Le Sage and Mascaigne[5] that the hyperacidity of the stomach may make a favorable medium for their growth.

Ulcer of the stomach in the course of development may cause complete perforation of the gastric wall. In the necrotic process the erosion of an artery may result in hemorrhage. Cure by cicatrization may

[1] *Edinburgh Hospital Reports*, 1894, vol. ii.
[2] *Lo Sperimentale*, July, 1889.
[3] *Archiv. gén. de Méd.*, Sept., 1881.
[4] *Compt. Rendus*, vol. cvi. No. 25.
[5] *Archiv. de Méd. expérimentale*, vol. iv. p. 350.

result in contractions. From the surgical point of view perforation of the stomach is one of the most important complications of ulcer, for it may lead to direct and fatal extravasation. Adhesions to neighboring organs, caused by a local peritonitis over the seat of the perforation, may prevent extravasation or may limit it to an abscess. Perforations occurring in this way may not give rise to serious symptoms. On the other hand, the perforation may be too rapid for the formation of limiting adhesions, and extravasations unimpeded involve immediately the peritoneal cavity. Perforations cured spontaneously may result in adhesions to almost any viscus. The pancreas is most frequently affected by adhesions, although it is rare to have pancreatic abscess from this cause. Cases of the latter have been reported, however, by Murchison[1] and Leith.[2] In rare instances adhesions between the stomach and the abdominal wall may result in cutaneous fistulæ: 12 such cases were collected by Murchison.[3] Perforations guided by adhesions to the colon, the duodenum, or the gall-bladder not infrequently cause permanent fistulæ between the stomach and these viscera. Ten cases of gastrocolic fistula were collected by Murchison.[4] Gastric ulcer in a similar manner perforating the diaphragm may cause empyema or pleurisy. Leith[5] refers to 4 recorded cases of perforation into the ventricle of the heart and 5 of perforation into the pericardium. Adhesions to the spleen are rare. Dickinson[6] from an analysis of 55 cases of perforating gastric ulcer from the St. George's Hospital records found that in half the cases circumscribed abscess resulted; in the remaining half, general peritonitis and death.

According to Weir,[7] gastric ulcer is probably a more frequent cause of subdiaphragmatic abscess than is commonly supposed. Dickinson[8] reports 2 cases of this kind, and Debove[9] a collection of 13. Other instances are recorded by Bennett,[10] who operated successfully upon a case, and by Kriege.[11] Debove dwells upon the difficulty of distinguishing at times between subdiaphragmatic abscess and pyopneumothorax. Mason of Boston in a paper read before the Association of American Physicians, 1893, published also in *Boston Medical Surgical Journal*, August, 1893, exhaustively reviewed the whole subject of subphrenic abscess, and reported four cases of his own caused by gastric ulcer. In pneumothorax, particularly of the left side, gastric ulcer should be borne in mind as a possible cause. Abscesses in the pelvis or in regions of the abdomen not in close relation with the stomach result occasionally from the perforation of gastric ulcers. Lander[12] refers to a case of pelvic abscess from this cause; Leith,[13] to a case of abscess low down in the left side. A tumor, supposed to be splenic, recently operated upon by Conant of Boston proved to be an abscess due to perforation of the stomach. Perforation into the abdominal cavity takes place in about 13 per cent. of all cases.[14] A less frequent accident in the course of gas-

[1] *Trans. Pathol. Soc. London*, vol. xvii. p. 145.
[2] *Edinburgh Hospital Reports*, vol. ii., 1894.
[3] *Med.-Chir. Trans.*, 1858, vol. xli. p. 17.
[4] *Edinburgh Med. Journ.*, 1857, vol. iii.
[5] *Loc. cit.*
[6] *Brit. Med. Journ.*, March 17, 1894.
[7] *International Medical Magazine*, Feb., 1892.
[8] *Lancet*, 1891, vol. i. p. 541.
[9] *Gazette des Hôpitaux*, 1890, p. 1150.
[10] *Lancet*, July 7, 1894.
[11] *Schmidt's Jahrbuch*, 1894, No. 9.
[12] *Med. Chronicle*, 1886, vol. iv. p. 306.
[13] *Loc. cit.*
[14] Michaux, *Revue de Chir.*, Nov., 1894.

tric ulcer is hemorrhage. This may result from the erosion of an artery of considerable size, and sometimes may cause rapid and alarming exsanguination. At other times the hemorrhage, though not excessive, persists until the patient is markedly anæmic. Cicatrizations and contractions may cause pyloric stenosis, with its remote changes in the shape and functions of the stomach. Occasionally such contractions result in deformities of the walls of the stomach itself, with or without functional disturbances (hour-glass contractions, etc.).

Symptoms of Gastric Ulcer.—The characteristic symptoms of gastric ulcer depend upon the more serious aspects of this disease. In many cases the lesion is not suspected until the symptoms of hemorrhage or of perforation appear. In others the signs are so insignificant that a positive diagnosis is never made. Simple ulcer of the stomach, without hemorrhage and without perforation, may give rise merely to the symptoms of gastric irritation. Pain and distress after eating are usually present, with vomiting and gastric tenderness. The pain, usually referred to the back, is boring in character and is relieved by pressure or by food. In most instances, sooner or later, hemorrhage takes place. It may be slight or excessive, continuous or intermittent. The amount is seldom so great as to cause alarming symptoms, though rapidly fatal hemorrhage may follow the erosion of large arteries like the gastric or pancreatic. Repeated hemorrhages lead to a characteristic anæmia. In these cases the symptoms are often vague until hemorrhage takes place. Being changed by digestion, the blood varies in appearance with the length of time that it has remained in the stomach. It is usually bright in color. Passed by rectum, it may cause tarry stools.

The symptoms of perforation vary with the direction and with the extent of the extravasation. If adhesions exist between the stomach and other organs, the resulting fistula may give rise to no symptoms whatsoever. Extravasations controlled by adhesions are attended by the symptoms of localized abscess; general peritoneal infections, by the symptoms of general peritonitis. The rarer complications of perforation —*e. g.* subdiaphragmatic abscess, pyopneumothorax, remote abscesses— give rise to characteristic signs. The possible gastric origin of these lesions should be borne in mind even if a definite history of gastric ulcer cannot be obtained.

Pyloric stenosis from the cicatrization and contraction of ulcers is attended by the symptoms of dilated stomach. Other deformities of the stomach resulting from ulcer may give rise to no symptoms at all or may cause merely those of functional gastric disturbance. Adhesions to contiguous viscera not infrequently cause severe and obstinate gastralgias. Fistulous communications with other viscera rarely if ever show signs of their presence.

Radical as well as palliative surgical measures in the treatment of gastric lesions depend upon a positive diagnosis of the disease; hence the importance of an early differential diagnosis between ulcer and cancer of the stomach. Hemorrhage and perforation, however, may demand prompt exploration, without regard to the nature of the primary disease; hence the importance of the earliest possible recognition of these conditions.

A positive differential diagnosis between ulcer and cancer is at times

extremely difficult, and may be impossible. The chief points of difference are the following: Ulcer occurs as a rule in young women; cancer, though sometimes seen before the age of thirty, is usually a lesion of later life. The pain of ulcer comes on after eating, and is relieved by food; that of cancer is usually constant and dull. In ulcer the pain shoots or bores through to the back; in cancer in later stages it is in the shoulder. In ulcer the appetite is good at times; in cancer it is always bad. In ulcer the digestion of meat is normal and rapid; in cancer the digestion of all kinds of food is impaired. In ulcer vomiting occurs after eating; in cancer, when the stomach is empty. Ulcer is marked by anæmia; cancer, by cachexia. In ulcer the pallor of anæmia is at times extreme, especially in young women; in cancer, cachexia comes on early, progresses rapidly, and the patient has a characteristic straw color. In ulcer the blood vomited is usually unchanged; in cancer it has the familiar coffee-grounds appearance. In ulcer acidity may be increased; in cancer hydrochloric acid is diminished or absent. Finally, the presence of an epigastric tumor is strongly indicative of cancer, though it may appear in ulcer. To sum up: if gastralgia, hæmatemesis, and anæmia are present, without cachexia or tumor, especially if the patient is young, ulcer probably exists. If in a patient beyond middle life there are pain, cachexia, vomiting of changed blood, rapid emaciation, and loss of strength, cancer is presumably present. The presence of an irregular, hard tumor makes the diagnosis of cancer clear, especially if free hydrochloric acid is absent and if in the vomitus cancer-cells are found. In rare instances ulcer and cancer may coexist, from malignant degeneration of the former. (For comparative differential diagnosis see tables under Cancer.)

The existence of a tumor in the gastric wall can sometimes be demonstrated by the use of the gastro-diaphanoscope. This instrument, of doubtful value when the abdominal walls are thick, will at times reveal with great certainty the presence of a tumor in the anterior wall of the stomach. A tumor that can be demonstrated in this way, however, can probably be felt in the epigastrium. Little information as to the condition of the stomach can be obtained by exploration with sounds; in their use, moreover, there is always danger of perforation. In some instances the gastroscope may be used, though it is of doubtful efficacy. The diagnosis should rest, if possible, upon the history and the physical examination.

Diagnosis of Hemorrhage.—Hæmatemesis dependent upon gastric ulcer must not be mistaken for hemorrhage from other sources. If from the lungs, œsophagus, pharynx, mouth, or nose, careful examination will usually make the source plain. The possibility of gastric hemorrhage in the course of cirrhosis of the liver must be borne in mind.

Bleeding from the stomach severe enough to demand interference is extremely rare. Vomiting of large quantities of bright blood, with the general signs of exsanguination, establishes the diagnosis. Internal hemorrhage, not demonstrated by vomiting, is recognized by the usual signs—pallor, rapid and feeble pulse, restlessness, and thirst.

Diagnosis of Perforation.—The early diagnosis of perforation into the general abdominal cavity is the most important consideration in connection with gastric ulcers. Occurring in the course of this disease,

sudden pain in the epigastrium, followed by shock and collapse, indicates general peritoneal invasion from perforation of the stomach. Vomiting may be an early symptom, though it seldom occurs until the peritonitis is fully developed, when it is persistent and excessive. The usual signs of general peritonitis rapidly supervene. Most observers mention an area of tympany over the epigastrium appearing very soon after perforation. When the extravasation is limited by adhesions the signs of general peritoneal infection are absent. Though the pain is the same, collapse and shock are less. The patient rapidly rallies, and shows by rise of pulse and temperature a moderate septic absorption. The signs of local abscess are soon apparent.

The diagnosis of gastric adhesions cannot be made except by exploration. They may be suspected when gastralgia and other functional disturbances persist after the healing of gastric ulcers.

Pyloric stenosis can be conjectured from the presence of a dilated stomach. Deformities and contractions in other parts of the stomach may give rise to functional disturbances, but their existence can only be suspected. (For the consideration of pyloric stenoses, dilatations of the stomach, etc. as the remote results of gastric ulcer, see page 268.)

Operations for gastric ulcer are indicated in perforations, in severe hemorrhages, in painful adhesions, and in fibrous contractions of healed ulcers. (For the last see Pyloric Stenoses.) In exceptional cases they may be performed for the extirpation of the ulcer itself. The first radical operation upon gastric ulcer was performed by Mikulicz in 1880, with fatal result. The first successful case was operated upon by Kriege.[1] Michaux[2] found only 25 cases in which operation was performed for perforation. The first 10 cases were fatal; in the last 15 there were 5 recoveries and 10 deaths.

Up to the present time 44 cases of operation for acute perforating gastric ulcer have been found by the author, 43 of which were performed after perforation had taken place; 1 for hemorrhage before perforation. Out of the 44 cases, only 10 recovered. Howard's case died of empyema in the eighth week. Thus, with 34 deaths and 10 recoveries, there is a mortality for the series of 77.27 per cent.

Successful operations have been done by Kriege, Morse, Maclaren, Michaux, Roux, Nicolson, Bennett, Atherton, Schuchardt, and Kuester.

If the cases for 1894 and 1895 be considered independently, we find 21 cases with 9 recoveries and only 12 deaths, a mortality of only 57.01 per cent.—a much more gratifying percentage.

All the cases found are given in the tabular view with full bibliography on p. 259.

Pariser[3] gives a series of 43 cases, but 3 of his cases are not authentic, and he does not include those of Atherton, Schuchardt, or Weir.

Kuester[4] operated successfully when perforation was imminent. The symptoms were those of dilated stomach with sharp hemorrhage. An ulcer as large as a half-dollar (diameter, 3.1 cm.) was found near the pylorus; it was simply cauterized, because it could be neither freed nor excised. Romme[5] urges operation before perforation has taken place.

[1] *Berlin. klin. Woch.*, Dec. 5, 1892.
[2] *Revue de Chir.*, Nov. 10, 1894.
[3] *Deut. med. Woch.*, 1895, No. 28.
[4] *Archiv klin. Chir.*, 1894, p. 787.
[5] *La Tribune médicale*, Jan. 12, 1893.

Tabular View of the Operation for Gastric Ulcer.

Operator.	Reference.	Sex.	Age.	Site of perforation.	Time of operation after perforation.	Result.	Remarks.
1. Czerny, 1888.	*Archiv f. klin. Chir.*, Bd. 37, S. 850.	F.	20	Middle of anterior wall.	5 days.	D.	Perforation not found at operation.
2. Czerny.	*Ibid.*	M.	33	Ant. wall, near pylorus.	50 hours.	D.	
3. Bartlett, 1888.	*Birmingham Med. Rec.*, 1888, p. 183.	. .	. .	. . . . .	. . .	D.	Case cited by Gilford.
4. Köhler, 1888–89.	*Charité Annal.*, vol. xv. p. 450.	M.	24	Lesser curvature.	. . .	D.	Perforation not found at the operation.
5. Ibid.	*Ibid.*	F.	47	" "	18 hours.	D.	
6. Heusner (Kriege), 1888.	*Berlin. klin. Woch.*, 1892, 49.	F.	21	Ant. wall, near cardiac end.	33 hours.	D.	
7. Mikulicz, 1889.	*Archiv f. klin. Chir.*, 39, p. 756.	F.	17	Mid. ant. wall, near pylorus,	36 hours.	D.	Second ulcer on post. wall.
8. Stelzner, 1889.	*Verhandl. Deut. Gesellsch. Chir.*, 1889, No. 98.	F.	Young.	(?)	18 hours.	D.	
9. Stelzner, 1889.	*Ibid.*	F.	Young.	(?)	48 hours.	D.	[at operation. Ulcer not found
10. Sinclair, 1889.	*Med. Chronic.*, May, 1889.	. .	. .	. . . . .	. . .	D.	No data. Case cited by Gilford, 1893.
11. Nissen, 1890.	*St. Petersb. Woch.*, 1890, 41.	M.	46	Ant. wall, near sm. curvature.	5 days.	D.	Perforation not found at operation.
12. Mouissait, 1890.	Cited by Mintz Pariser.	. .	. .	. . . . .	. . .	D.	
13. Oergel, 1891.	*Inaug. Disser.*, Greifswald, 1891.	F.	20	Ant. wall, near cardiac end.	60 hours.	D.	
14. Kriege, 1892.	*Berlin. klin. Woch.*, 1892, 49, 50.	M.	41	Ant. wall, near cardia.	16 hours.	R.	
15. Körte, 1892.	*Verhandl. der Deut. Gesellsch.*	F.	71	Post. wall.	48 hours.	D.	
16. Simon and Barling, 1892.	*Brit. Med. Journ.*, Jan. 9, 1892.	F.	22	Mid. ant. wall, toward cardia.	(?)	D.	
17. Ibid.	*Ibid.*	F.	20	Mid. ant. wall.	4 days.	D.	
18. Leucke, 1892 (Pinner).	*Centralb. f. Chir.*, 1892, No. 28.	F.	Young.	Small curvature, ant. wall, near card. end.	36 hours.	D.	
19. Haward, 1893.	*Brit. Med. Journ.*, 1893, vol. i. 944.	F.	26	Post. wall.	14 hours.	D.	Recovered from operation. D. in eight weeks from empyema.
20. Haslam, 1893.	*Lancet*, 1893, vol. ii. 327.	F.	17	Near cardia.	"Few hours."	D.	
21. Gilford, 1893.	*Brit. Med. Journ.*, 1893, i. 944.	F.	20	Cardiac end, near post. wall.	10 hours.	D.	
22. Sterling, 1893.	*Australian Med. Journ.*, 1893, 291.	. .	. .	. . . . .	. . .	D.	Cited by Gilford.
23. Morse, 1894.	*Brit. Med. Journ.*, 1894, i. 576.	F.	20	Near cardia.	5 hours.	R.	
24. Maclaren, 1894.	*Ibid.*, vol. ii. 863.	F.	23	Ant. wall, near gr. curvature.	9 hours.	D.	
25. Ibid.	*Ibid.*	F.	14	Ant. wall, an inch fr. cardia.	9 hours.	R.	
26. Ibid.	*Ibid.*	F.	20	Ant. wall, 2 in. from cardia.	4 hours.	D.	
27. Page, 1894.	*Lancet*, 1894, i. 672.	. .	. .	. . . . .	40 hours.	D.	
28. Ibid.	*Ibid.* [1894.	. .	. .	Ant. wall, near cardia.	18 hours.	D.	
29. Michaux, 1894	*Revue de Chir.*, Nov.,	. .	. .	" "	(?)	R.	
30. Roux, 1894.	Cited by Michaux, *Ibid.*	. .	. .	. . . . .	. . .	R.	
31. Nicolson, 1894.	*Brit. Med. Journ.*, 1894, ii. 982.	F.	32	Ant. wall, near œsophagus,	3 hours.	R.	
32. Pepper, 1894, cited by Gould.	*Ibid.*, 861.	. .	. .	Ant. wall, near sm. curvature.	36 hours.	D.	
33. Morris, 1894.	*Ibid.*	. .	. .	" "	36 "	D.	
34. Morrison, 1894	*Ibid.*, 864.	. .	. .	Lower wall (?).	2 hours.	D.	
35. O'Callaghan, 1894.	*Ibid.*, 865.	. .	. .	. . . . .	24 hours.	D.	
36. Ibid.	*Ibid.*	. .	. .	. . . . .	24 "	D.	
37. W. J. Maurice, 1894.	*Lancet*, June, 1894.	F.	23	Ant. wall, small curvature.	14 hours.	D.	
38. Bennett, 1894.	*Lancet*, 1894, ii. 21.	F.	41	Post. wall, near pylorus.	8½ hours.	R.	
39. Swain, 1894.	*Ibid.*, p. 22.	F.	26	Post. wall, near cardia.	19 hours.	D.	
40. Atherton, 1894	*Med. Record*, 1895, Jan. 5.	F.	20	Ant. wall, near pylorus.	24 hours.	R.	
41. Schuchardt, 1895.	*Archiv f. klin. Chir.*, vol. 50, 617	F.	21	Ant. wall, 6 cm. from cardia.	10 days.	D.	Purulent peritonitis.
42. Ibid.	*Ibid.*	F.	16	Ant. wall, near gr. curvature.	2½ days.	R.	
43. Küster, 1894.	*Archiv klin. Chir.*, 1894, 787.	F.	21	Post. wall, near pylorus.	. . .	R.	Operation done for hemorrhage before perforation.
44. Weir, 1892.	*Inter. Med. Mag.*, Feb., 1892.	. .	. .	. . . . .	. . .	D.	

Surgical interference should be practised as soon as possible after the initial pain of perforation. The recent successful cases have been operated upon within, at most, twelve hours; Morse's within five hours; Gilford's within eight. Unless the shock is so excessive that interference is practically hopeless, immediate exploration is demanded, because of the extreme rapidity with which a general infection may be developed. To await reaction is to abandon the patient to a hopeless infection. An incision large enough to admit the hand should be made in the median line between the ensiform cartilage and the umbilicus. Unless the stomach is small and firmly contracted, this cut permits full exposure and unimpeded manipulation, especially in lesions near the pylorus. If more room is required, the abdominal incision may be enlarged transversely. If possible, the stomach should be drawn out of the wound far enough to permit thorough examination. If delivery through the wound is for any reason impracticable, inspection and digital exploration may demonstrate the situation and extent of the lesion. Free delivery may be impossible if the stomach is small or contracted or if it is fixed by adhesions.

If exploration is performed for perforation, the seat, shape, and size of the opening must first be accurately determined. The prevention of further escape of gastric contents requires attention before removal of that which has already been extravasated. If the opening is small and the gastric walls about it are soft and pliable, closure may be accomplished by inverting the peritoneal edges and sewing them together. If extensive infiltrations prevent satisfactory approximation, the entire external surface of the stomach corresponding to the ulcer may be infolded and sutured. This method causes the whole ulcerated surface to project inwardly and effectually prevents further extravasation. The possibility of infolding the seat of the ulcer depends upon the laxity of the gastric wall. The peritoneal surface over the ulcer should be depressed and held, while by means of two or three interrupted sutures the lax gastric walls outside the limits of the ulcer are brought together over the inwrapped diseased surface. The infolding can now be rapidly completed by stitching in both directions. The line of suture must depend somewhat upon the situation of the ulcer and upon the facility with which the gastric walls may be brought over the infolded portion. Less traction will be necessary if the fold is brought in the transverse direction. When from the shape, size, or situation of the disease infolding is impracticable, the whole ulcer may be excised and the resulting wound closed. The mucous surfaces should first be united by an interrupted suture of silk or catgut; the edges of the wound should then be brought together by inverting the peritoneal surfaces and fastening them by sutures. If excision of the ulcer will evidently produce a wound that cannot be closed efficiently, and if infolding is also impracticable, the perforation should be controlled by means of gauze so placed as to provide an easy channel of exit through the external wound. If the opening is in the anterior wall of the stomach, the gauze may be packed spirally between the stomach and the abdominal wall, with the perforation at the bottom; if in the posterior wall, drainage-tubes of large size, surrounded by gauze, should be used.

When, after excision, the difficulties in the way of successful closure

are insurmountable, the edges of the wound in the stomach may be stitched to the abdominal wound and a temporary gastrostomy effected. Such a wound in the posterior wall of the stomach can be controlled only by means of gauze barriers. These devices are, however, extremely unsatisfactory, and one should therefore make sure that the stomach-wound can be efficiently closed before excising the ulcer.

As soon as the perforation has been firmly closed by suture the material already extravasated may be removed and the peritoneal cavity cleansed. If the perforation can be controlled only by gauze barriers, cleansing of the abdominal cavity should be done first.

When exploration is made for hemorrhage, complete extirpation of the ulcer by excision and suture is indicated. If radical removal of the disease is impossible, the ulcer may be exposed by gastrotomy and the bleeding points secured.

When for other reasons than perforation or hemorrhage the excision of gastric ulcers is indicated, the methods already described should, if practicable, be followed. Radical removal should not be attempted, unless the local conditions are favorable for efficient closure of the gastric wound.

With reference to cleansing the peritoneal cavity after operations upon gastric ulcers authorities differ. After operations most of the operators have used free irrigation and drainage. Bennett[1] in his successful case used neither. Michaux recommends free incision, irrigation, and drainage. Pearce Gould[2] urges thorough irrigation with normal salt solution. Page gives no mention of drainage in his two cases, though both died. The best method of drainage is the use of gauze in some form.

(For the after-treatment see Operations upon the Stomach and for the treatment of general infections see Peritonitis.)

Localized abscesses resulting from the perforation of gastric ulcers require incision and drainage, like abdominal abscesses from other causes. When the abscess is deeply seated operation for drainage at times necessarily opens the general cavity of the abdomen. In such cases great care must be taken to avoid a general infection. When situated in the lesser cavity of the omentum (subdiaphragmatic), localized abscesses should be reached by dividing the layers of omentum between the stomach and the transverse colon. If the omentum is not adherent to the anterior abdominal wall, before evacuating the abscess gauze should be arranged in the form of a ring about the area of proposed incision. In many instances the abscess, by successive adhesions, will have approached the surface before its presence is demonstrated. In such cases simple incision and drainage can be used without danger of causing a general peritoneal infection. In other cases the treatment varies with the extent and situation of the abscess and the organs involved.

(For the treatment of General Peritonitis from the perforation of gastric ulcers see Peritonitis.)

TUMORS OF THE STOMACH.—The neoplasms which may occur in the stomach-wall are myofibromata, adenomata, sarcomata, and carcinomata. Of these the only one of especial surgical importance is carcinoma.

Sarcoma of the stomach, though very infrequent, does occur. Two

[1] *Loc. cit.* [2] *Loc. cit.*

instances of malignant lymphoma of the stomach have been reported by Torok of Vienna.[1] In one Von Hacker removed a piece of the stomach measuring 12 cm. on the lesser curvature and 27 cm. on the greater; in the second Billroth resected a somewhat smaller piece.

Adenoma, one of the rarest tumors of the stomach, may simulate cancer, as in the case of Chaput's exhibited in 1894 before the Société de Chirurgie of Paris. The patient, a man of sixty-four, was supposed to have cancer of the stomach. The diagnosis was based upon

FIG. 171.

Polypoid growth of the stomach (Warren Museum).

a tumor in the epigastrium accompanied by emaciation and coffee-ground vomitus. At the operation an adenoma, covered with normal mucous membrane, was found attached by a small pedicle to the posterior wall of the stomach. The patient recovered.

Cancer of the Stomach.—Carcinoma exceeds in frequency and importance all other neoplasms of the stomach. Between 0.5 and 2.5 per cent. of the mortality from all causes is due to gastric cancer. Moreover, in between 35 and 40 per cent. of all cases of cancer the disease originates in the stomach. Welch's analysis of 2075 cases and Brinton's of 600 show that three-fourths of the deaths from this disease occur between the ages of forty and seventy. Cancer is very unusual before the thirtieth year of life, and it is never congenital. Both sexes are affected with equal frequency. The disease is usually primary and its cause as a rule uncertain.

Among the causes which have been assigned to cancer of the stomach are internal and external violence, chronic irritations, acute inflammations, and the degenerations of cicatrices resulting from chronic ulcers, from corrosive poisons, and from other superficial necroses.

With reference to malignant degeneration of cicatrices resulting from gastric ulcer, the weight of authority is in the affirmative—Lebert and Dittrich, Myer, Heitler, Hauser, and Flatow (quoted by Ewald).[2]

Cancer of the stomach may be scirrhous, encephaloid, colloid, poly-

[1] *Centralblatt für Chir.*, Aug. 13, 1892. [2] *Klinik der Verdauungs-Krankheiten*, vol. ii.

poid, villous, melanotic, or, in fact, of any known form (Fig. 172). The most common variety is the scirrhous, which is found in 75 per cent. of all cases; the colloid variety occurs in from 2 to 8 per cent. only. Cancer

FIG. 172.

Cancer of the cardiac end of stomach and œsophagus (Warren Museum).

may involve the larger portion of the gastric wall or it may be limited to a comparatively small section. The colloid type is usually seen as a flattened, "nutmeg-grater"-like growth extensively infiltrating the stomach-wall and but slightly raised above its surface. Villous forms are not uncommon. When extensively involved by the disease the stomach is usually small and contracted and adhesions to adjacent organs are common.

The scirrhous variety of cancer of the stomach is by far the most frequent, and, from the surgical point of view, the most important, for it affects the orifices of the stomach in from 70 to 75 per cent. of the cases, the pylorus in 60, the cardiac orifice or the lesser curvature in 10. Ulcer, on the contrary, involves the orifices in from 16 to 18 per cent. only. The fundus is affected least frequently—19 times in the 1300 cases of Welch. Scirrhous cancer is usually sharply localized, tending to grow in depth and in height. Cancer situated at either orifice of the stomach may produce stricture. Pyloric stenosis from this cause is not uncommon. Stricture at the cardia occasionally results when the disease involves the lower extremity of the œsophagus. Pyloric stenosis may cause excessive dilatation of the stomach (Fig. 173).

The ulcerations of cancer may vary in depth, in breadth, and in number. At times several small superficial ulcers will be found; at others, a simple deep crater. The edges of the ulcer are hard, irregular,

and sharply defined; its base is friable and uneven. Ulceration occurs most frequently in the medullary form, less often in the scirrhous, and rarely in the colloid variety. Hemorrhage from the ulcerated surface

FIG. 173.

Cancer: a large fungous growth at the pylorus, with dilatation and hypertrophy of the walls (Warren Museum).

is usually slow and insignificant, though in rare instances it may be rapid and extensive. Perforations may take place in any direction, most frequently into the peritoneal cavity or into the intestines. They follow the same course as perforations from ulcers, and give rise to the same group of symptoms. According to Brinton, perforation occurs in 4 per cent. of the cases. Extravasations limited by adhesions may be slow and insignificant; when unrestrained they may be fulminating and fatal. Guided by adhesions, perforation may take place through the anterior abdominal wall. An external fistula may be formed in this way. Mislowitzer collected 16 cases of anterior perforation. Another case is reported by Ewald[1] from Gerhardt's clinic. Localized peritonitis and abscess, occurring in the course of gastric cancer, sometimes mask the primary disease. They may be situated in close relation with the stomach or they may be remote.

Metastases in cancer of the stomach may take place into any of the neighboring organs. The liver is affected in from 25 to 30 per cent. of all cases; the peritoneum, in from 13 to 22.7 per cent.; the lungs and pleuræ, in from 0.6 to 6.2 per cent. Though infection of the lymphatics may occur, it is said not to be as frequent or as rapid as in cancer elsewhere. Brinton[2] observed lymphatic infection in 23.5 per cent. of his

[1] *Loc. cit.* [2] *Loc. cit.*

cases; Welch, in 35 per cent. Implication of the supraclavicular lymph-glands has been regarded by Virchow, Henoch, Troisier,[1] and others as of diagnostic value in cancer of the stomach. Ewald regards such infection as unusual.

Attempts at radical extirpation of gastric cancer are justifiable only in the first stages of the disease; hence the importance of those symptoms upon which the earliest possible diagnosis may be based. When the signs of the disease are conspicuous only palliative measures are, as a rule, warrantable.

The **symptoms** of cancer of the stomach are in the beginning obscure. Digestion is first impaired; the appetite is poor and irregular; the bowels constipated. A sensation of fulness and pressure in the epigastrium, with at times a dull pain, is accompanied by occasional attacks of vomiting. The bodily weight and strength are somewhat diminished. These symptoms in a patient beyond middle life suggest the possibility of cancer of the stomach, especially if there is an hereditary tendency to the disease and if any of the predisposing causes have existed. Yet the diagnosis is only suggested by these symptoms, for no tumor is perceptible, the vomitus contains no blood, pain is insignificant, free hydrochloric acid may not be diminished, and cachexia is absent. Nevertheless, this is the time for exploratory laparotomy if radical extirpation is to be considered at all, for the disease at this stage is probably limited in extent and sharply defined, without ulcerations, metastases, or infiltrations. With the more extensive implication of the gastric walls digestion becomes seriously impaired and vomiting is excessive and persistent. Necrosis and ulceration of the malignant surface lead to hemorrhages by which the vomitus is discolored. Pain becomes constant and excessive, the loss of strength and flesh alarming, and cachexia conspicuous. In many cases these symptoms are hastened and increased by stenosis of the pylorus, with resulting gastric dilatation. The presence of an epigastric tumor, usually perceptible at this time, is hardly necessary to establish unmistakably the diagnosis. Only palliative treatment is defensible at this stage, for the disease is undoubtedly of wide extent, with deep ulcerations, local infiltrations, and remote metastases.

According to the statistics of Brinton and Lebert, pain is present in from 75 to 92 per cent., vomiting in from 80 to 88, hæmatemesis in 42, and tumor in 80. Tumor is seldom palpable before the third month. In the great majority of cases constipation exists.

The absence of free hydrochloric acid in the gastric juice—a symptom first noted by Golding Bird of London in 1842, and since thoroughly investigated by others—is not an absolute diagnostic test, for if the growth is small and the mucous membrane not extensively affected, secretion of hydrochloric acid may be ample till just before death. Hydrochloric acid is absent, too, in atrophy and in amyloid degeneration of the mucous membrane, in poisoning by corrosives, in certain catarrhs of the stomach, in acute infectious diseases, in various chronic diseases, such as Addison's disease, pernicious anæmia, and in many cases of phthisis. Though not pathognomonic, the absence of free hydrochloric acid points with great probability to cancer.[2]

[1] *Gazette hebdom*, 1886, No. 42.

[2] Ewald, *loc. cit*, and Oppler, *Deut. med. Woch.*, Jan. 3, 1895.

A more important diagnostic point is the presence of specific cancer-tissue in the vomitus or in the mass removed by the stomach-tube. This test is a positive demonstration only when large nests of typical cells are obtained.

The tumor in gastric cancer can be felt only when it is situated at the pylorus or in the anterior wall of the stomach. Its presence is of great diagnostic importance. In some instances the growth can be felt in the early stages of the disease; in others, very late or not at all. When situated at the pylorus, the mass is usually movable, irregular, hard, and tender; when on the anterior surface, it is more diffused, smoother, and less movable. The nature of a tumor can usually be made out with great accuracy, though certain comparatively rare conditions may simulate it, such as cicatrized ulcer, peritoneal adhesions, hypertrophy of the muscular coat, or foreign body. The diagnosis between these conditions and the cancerous mass in its earliest stages may be impossible without an exploration. A tumor of considerable size may be masked by ascites or by peritonitis.

Dilatation of the stomach due to pyloric stenosis may appear early in the disease and give rise to characteristic signs. (See Strictures of the Pylorus.)

The cachexia of carcinoma of the stomach is not, as a rule, marked until late in the disease. When present it is of great diagnostic importance. In some cases it may be absent entirely; indeed, the disturbances may be slight through the whole course of the disease, as in the case reported by Storer[1] in which complete colloid degeneration was present without morbid symptoms.

Hemorrhage from cancer of the stomach is seldom free enough to cause exsanguination. Though large vessels are rarely eroded, abundant oozing may take place from the necrotic surface and discolor the material vomited. In cancer this blood is usually so changed by digestion as to suggest the appearance of coffee-grounds. Perforations with local and with general infections manifest themselves by signs similar to those described under Gastric Ulcer.

The diagnosis of cancer of the stomach in its early stages can be made with certainty only by exploratory laparotomy; in its advanced stages the disease is usually unmistakable. In rare instances valuable information may perhaps be derived from the use of the gastroscope or the gastro-diaphanoscope. These instruments, however, in the majority of cases are of doubtful advantage—in the early stages because the lesions are seldom capable of demonstration; in the later, because the method is dangerous. Though perhaps of occasional service in the hands of the skilful and experienced, their general utility is questionable. By exploratory laparotomy, quite as safe a procedure, the exact nature, seat, and extent of the disease can be demonstrated. Max Einhorn[2] of New York has recently reported 2 cases of cancer of the stomach in which probable diagnosis was confirmed by means of the gastro-diaphanoscope. In April, 1895, Keen satisfactorily demonstrated in this manner a tumor of the anterior wall of the stomach. The diagnosis was confirmed by exploration.

[1] *Boston Medical and Surgical Journal*, Oct. 10, 1872.
[2] *New York Medical Record*, Jan. 19, 1895.

The treatment of cancer of the stomach by surgical means may be radical or palliative. Radical operations are possible only when the disease is limited to sharply-defined and accessible areas. They are contraindicated when the stomach is extensively infiltrated or when metastases exist.

Palliative operations are demanded chiefly in strictures of the pylorus. (See Operations upon the Stomach.)

Operations for hemorrhage from gastric cancer are justifiable in the early stages of the disease, when total extirpation may at the same time be attempted. In advanced cases interference by laparotomy is seldom if ever justifiable.

Local and general infections from perforations occurring in the course of cancer of the stomach should be treated like the perforations of gastric ulcer (*q. v.*).

STRICTURE OF THE PYLORUS.—Strictures of the pylorus may be congenital. They may be caused by twists of the stomach, by the presence of benign pyloric tumors, or by the pressure of tumors external to the pylorus; they may be spastic. Practically, however, the surgery of pyloric strictures is the surgery of cicatrized ulcers and of malignant disease. The other causes of stenosis are rarely seen and are of comparatively little importance. Congenital strictures have been described by Landerer[1] and by Maier.[2]

Great relaxation of the abdominal walls, with distention of the stomach, may permit a rotation by which the pylorus will be occluded. The possibility of such occlusion has been demonstrated on the cadaver (Kussmaul). Tumors of the liver, gall-bladder, pancreas, omentum, or retroperitoneal glands may by outside pressure cause pyloric obstruction. Bartels first called attention to the possibility of pyloric obstruction from the pressure of a movable right kidney. This cause, if it ever exists, must be extremely rare, though Litten (quoted by Ewald) noted gastric dilatation in connection with displaced right kidney in 55 per cent. of his cases. On anatomical grounds it seems unlikely that a misplaced kidney should often interfere with the lumen of the pylorus. Pyloric stenosis has been observed in cases of small polypoid tumors of the stomach and in tumors and diverticula of the duodenum. The existence of spastic strictures has not been positively demonstrated.

In pyloric obstruction the stomach is unable to empty itself with normal facility. The gastric walls, at first hypertrophied and possibly contracted, in the course of time become attenuated and weakened until a general dilatation of the stomach results. The increase in volume, though ordinarily moderate, may be excessive, the fundus at times sagging into the left iliac fossa or even into the pelvis. The diseased pylorus, dragged downward and toward the left, can often be felt as a movable tumor near the umbilicus. Traction upon the pylorus and duodenum, often extreme, especially if the stomach is distended by fluid, may increase the stenosis. In this manner dilatations, the result of causes other than stenosis, may cause an obstruction where none previously existed. Food undigested and long retained becomes decomposed and gives rise to eructations of foul-smelling gases or is itself

[1] *Inaugural Dissert.*, Tübingen, 1879.

[2] *Virchow's Archiv*, Bd. 102, 413.

vomited. Digestion becomes seriously impaired. The stomach in these conditions will at times hold an enormous amount of fluid.

The **symptoms** of pyloric stenosis are the symptoms of the causative disease wth those of dilated stomach. The symptoms of gastric ulcer and gastric cancer have already been described. The rarer causes of obstruction, already mentioned, seldom present characteristic features.

Whatever the cause may be, the symptoms of pyloric obstruction are chiefly the symptoms of dilated stomach. First appear digestive disturbances, which finally amount to almost complete loss of digestive power. Foul-smelling gases are belched, and food that was taken hours or days previously is vomited undigested and decomposed. Enormous quantities of fluid are occasionally vomited. At times there are complaints of discomfort and fulness in the epigastrium; at others of pain, sharp or dragging. Objective signs of a moderately dilated stomach are wanting. If dilatation is excessive, the fundus can often be felt as a fluctuating tumor low in the left side. This tumor may be mistaken for an ovarian or other cyst. Palpation will show succussion, and the tumor will disappear in the recumbent or in the inverted position. When fluid and gas fill the stomach, succussion will be perceptible on palpation or during certain movements of the body. Artificial distention of the stomach by means of a stomach-tube or by means of Seidlitz powders will show the exact size and shape of the organ.

The **diagnosis** between the dilatations of simple atony and those dependent upon pyloric disease can be made by excluding the latter. In cicatricial stenosis the history of gastric ulcer usually precedes the symptoms of chronic dilated stomach. In this form, as in benign strictures from other causes, the course of the disease is slow, the patient living for many years in tolerable comfort under medical treatment. The absence of a tumor does not exclude malignant disease, for the cancer may be annular, and cause extreme stenosis without being large enough to be felt. The distinction between malignant tumors infiltrating the pylorus and benign growths obstructing the lumen by internal or by external pressure can usually be made from the slow growth and characteristic signs of the latter. Yet in some cases it is impossible without exploration to distinguish between benign and malignant stricture.

Practically, the only **treatment** for pyloric obstruction is surgical. Before resorting to operation, however, always provided cancer can be eliminated, medical treatment should be exhausted. This consists in careful regulation of the diet and the use of electricity and massage. If the dilatation results from atony of the gastric wall or from a slight obstruction, systematic lavage of the stomach may result in complete relief to the symptoms, especially if the dilatation is so excessive as to drag upon and obstruct the pylorus. Improvement under medical treatment —massage, electricity, lavage, and regulation of diet—will not only contraindicate radical measures, but will render the diagnosis of pyloric obstruction improbable.

The *surgical treatment* of pyloric stenosis is either radical or palliative. By palliative treatment either the stricture is dilated after gastrotomy or an artificial outlet is made between the stomach and the intestine. Radical cure demands mechanical restoration of the lumen at the point of stricture.

The radical operative treatment of malignant pyloric stenosis, to be successful, must be undertaken at the earliest possible moment, when the disease is distinctly limited to the pylorus; that of benign obstructions, before the patient's powers of resistance are seriously impaired. The radical operations are pylorectomy and linear pyloroplasty. Palliative measures include dilatation and curetting after a preliminary gastrostomy or a gastro-enterostomy.

Lavage of the stomach can best be accomplished through the soft-rubber tube and funnel of Kussmaul. The patient himself soon learns to swallow the tube and to make systematic and thorough irrigations. Careful cleansing in this manner should be employed before all operations upon the stomach.

(For the Radical and Palliative Operative Treatment see Operations upon the Stomach.)

FOREIGN BODIES IN THE STOMACH.—Foreign bodies may be swallowed accidentally or intentionally or they may form gradually in the stomach. The former comprise any substances small enough to pass the pharynx and the œsophagus; the latter are produced by the rolling together of indigestible materials swallowed from time to time, such, for instance, as hair or straw, bodies being formed similar to those found in cattle. Gastroliths, usually of vegetable formation, very rarely have been observed from the agglutination of starch with mucus. Bodies of such shape and size as to enter the stomach safely will, as a rule, pass on unimpeded. Occasionally, however, they are arrested, especially if they have sharp points or angles. The commonest foreign body in the stomach is the dental plate. If left to itself, this will usually pass on and be safely delivered *per anum* or become impacted there.

Gastroliths or balls of hair or of straw sometimes attain enormous dimensions. The so-called gastric calculi, though rare, occasionally attain great size. In Kooyker's case[1] a gastrolith composed of starch, mucus, and chlorophyl weighing 885 gm., was found at autopsy. Gastric ulcer had been diagnosticated in a man of thirty-five who declined operation. Hair-balls may cause an erroneous diagnosis of gastric tumor. Bollinger[2] reports such a case in a woman. A mass of straw nearly filling the stomach was found some years ago in a dissecting-room subject at the Harvard Medical School. The patient, hopelessly insane, had been in the habit of swallowing straw and other indigestible material. Knives, forks, spoons, tooth-brushes, and elongated objects generally fail to pass the pylorus. Foreign bodies may remain for a long time in the stomach without giving rise to symptoms. A number of such cases have been reported.[3] On the other hand, the pressure of a pointed body upon the gastric wall may result in ulceration and in perforation. A number of cases of spontaneous evacuation of foreign bodies by perforation through anterior adhesions have been reported. Hair-balls may give rise to no symptoms whatever or the gastric functions may be seriously impaired.

The **diagnosis** of a foreign body in the stomach can usually be made with accuracy unless, as in suicides and in lunatics, the history is wanting.

[1] *Zeitschrift für klin. Med.*, Bd. 14, Heft 3.
[2] *Münch. med. Woch.*, 1891, vol. xxxviii. p. 383.
[3] *Boston Medical and Surgical Journal*, Dec. 16, 1886.

Pain in the epigastrium, with fever, following shortly after the swallowing of a foreign body, indicates some serious gastric lesion. The symptoms of perforation, with localized or general peritonitis later, may appear. When a suicidal tendency exists or when the patient is insane, acute gastric symptoms should lead to the suspicion of an impacted foreign body. In some cases the diagnosis may be confirmed by the use of an ivory or a metal probang, which, coming in contact with the object, will give unmistakable evidence of its presence. The failure to strike such an object in this way, however, is not conclusive of its absence.

In the palliative treatment of foreign bodies in the stomach cathartics should be employed with caution. It is well to make use of such foods as will facilitate the passage of the body through the intestine. The "Vienna treatment" consists in a diet of mashed potatoes. Oakum has been given in the hope that its shreds might become wrapped about the sharp points and edges of the body. Large elongated bodies, such as knives, forks, spoons, tooth-brushes, etc., must be removed by gastrotomy, for there is little chance of their safe passage through the pylorus. Moreover, instrumental delivery is much safer than spontaneous cure by adhesion-formation and perforation of the abdominal wall. (For the description of this operation see Gastrotomy.)

Gastric Fistulæ.—By perforation through an adhesive peritonitis gastric fistulæ may result from wounds, ulcer, cancer, and foreign bodies. They may be external or internal. When internal, gastric fistulæ may never be suspected; indeed, cases are recorded in which persons have lived for many years with them. Fistulæ from cancer are usually of short duration. External gastric fistulæ usually close spontaneously, especially if the wound is kept clean and the granulations are stimulated. If the opening does not heal in this way, the external wound may be refreshed and closed by sutures. Though this method has the advantage of not opening the peritoneal cavity, it is likely to fail. The more radical, more certain, and probably more dangerous method consists in closing the gastric opening, after separating completely the adhesions between the stomach and the abdominal wall, and delivering the stomach through the wound. The edges of the fistula in the stomach should be resected and the raw surfaces infolded and sutured by any of the better intestinal methods. (See Treatment of Intestinal Fistulæ.) With this procedure there is some danger of a general infection from the unavoidable opening of the peritoneal cavity. By great care and by the use of gauze barriers the danger of peritoneal infection is rendered slight. To provide against the giving way of the stitches a small gauze wick should be placed over the line of suture and allowed to project from the external wound, or the presenting stomach-wall, after the closure of the fistula, may be sewed to the edges of the abdominal wound and the whole closed by external sutures. The stomach should be emptied and washed out by means of the stomach-tube before this operation. The after-treatment requires for forty-eight hours rectal feeding.

Operations upon the Stomach.—*Preparation of the Patient for Abdominal Operation.*—Whatever the operation upon the abdomen, it is desirable that the stomach and intestines should be empty. For this purpose mild cathartics should be given a day or two beforehand and an enema the morning of the operation. If the stomach itself is to be

opened, preliminary lavage is essential, especially if the operation is likely to be attended by extravasation. In case there is no obstruction at the pyloric orifice, abstinence from food for twenty-four or forty-eight hours will empty the stomach sufficiently to make irrigation unnecessary. The skin of the abdomen should first be shaved, then scrubbed most thoroughly by means of a brush with soap and water. Ether should next be used to dissolve the fat. A dressing of cotton moistened with 1 : 3000 solution of corrosive sublimate should be applied and kept on until the hour of operation. Just before incision it is well to scrub again with a solution of 1 : 1000 corrosive sublimate. The field should then be washed off with sterilized water and dried with sterile towels.

The operations upon the stomach are—

1. Gastrotomy ;
2. Gastrostomy ;
3. Loreta's operation ;
4. Pyloroplasty ;
5. Pylorectomy or gastrectomy ;
6. Gastro-enterostomy ;
7. Gastrorrhaphy ;
8. Simple explorations.

Gastrotomy.—The term "gastrotomy," as now used, applies simply to incision through the stomach-wall. In the beginning gastrotomy was synonymous with laparotomy. Gastrotomy is used for the removal of foreign bodies from the stomach or from the œsophagus, for the treatment of growths upon the internal wall, for dilatation of cardiac and œsophageal strictures, for instrumentation of the pylorus, and for exploratory purposes. Gastrotomy differs from gastrostomy only in the immediate closure of the gastric wound. Treves[1] follows Smith and Durham in attributing the first recorded gastrotomy to Shoval in 1635 ; others ascribe the procedure to Matthias of Prague, who is said to have performed the operation in 1602.

The incision for gastrotomy, made in the median line between the umbilicus and the ensiform cartilage, should not at first be more than two or three inches in length, for through such a wound the stomach can usually be drawn far enough to permit the subsequent manipulations, especially if the gastric walls are lax. If the stomach is naturally small or is contracted, and easy delivery therefore impossible, the incision must be enlarged sufficiently to allow the operation to be completed inside the abdominal cavity. In this case the difficulties will be considerably increased. If the operation is performed for foreign bodies, great care must be taken that no injury is produced by their sharp edges in delivering the stomach through the wound. When an extensive preliminary exploration is desirable, the cut should be long enough to admit the hand, by means of which the location of the foreign body, the situation of internal disease, and the condition of the pylorus or the cardia can be fully determined before delivery of the stomach is attempted. The extension of the incision and the delivery of the stomach will be regulated by the results of such exploration. It is desirable before incising the stomach to protect the surrounding parts thoroughly by means of sterile gauze. Such protection is essential if the stomach can-

[1] *Operative Surgery*, vol. ii.

not be drawn out of the wound. The direction and extent of the incision through the stomach-wall depend upon the lesion. If a small opening only is necessary, a transverse incision is less likely to cause hemorrhage than a longitudinal one; yet the danger from hemorrhage is slight, even in an extensive longitudinal cut, if it is made halfway between the greater and the lesser curvatures. Here the only vessels divided will be the anastomosing branches of the gastric and the epiploics. For digital or for instrumental operations upon the œsophagus or the pylorus the opening in the stomach should be small. (See operations under Œsophagus.) In some cases digital exploration of the œsophagus requires a cut large enough to admit the whole hand. For digital exploration of the pylorus the opening should be near that extremity and just large enough to admit the finger.

In *gastrotomy for the removal of foreign bodies* the length of the incision depends upon the shape and size of the body. It should be made midway between the curvatures and parallel with them, usually far enough to the right to permit digital examination of the pylorus. Extraction may be accomplished with any grasping instrument long enough to reach the foreign body, care being taken not to injure the stomach by sharp points or by cutting edges.

In closing the gastric wound the mucous membrane may or may not first be united by a continuous suture of silk or of catgut. The serous surfaces should next be inverted and fastened after the manner of intestinal suture. The interrupted or continuous Lembert suture is especially advantageous for this purpose. The abdominal wound can usually be closed immediately and completely and the stomach dropped back into its normal position. If closure of the wound without drainage is ever justifiable in the surgery of the alimentary tract, it is after clean gastrotomies. The after-treatment in gastrotomy, as in all operations upon the stomach, requires for the first forty-eight hours rectal alimentation. Careful feeding by the mouth may then be employed. The prognosis depends upon the condition requiring operation rather than upon the operation itself. In simple gastrotomies, when no organic disease is present, it is very favorable.

Gastrostomy.—Gastrostomy is almost always performed in œsophageal stenoses for the purpose of feeding. It consists in making a permanent gastric fistula through which food may be introduced. The operation was first suggested by Egeberg, a Norwegian, in 1837. It was first performed by Sedillot of Strasburg in 1849. The operation was performed experimentally upon animals by Bassow of Russia in 1842 and by Blandot of France in 1843. The early operations upon the stomach for artificial feeding were almost invariably fatal. After some twenty-eight deaths as a result of the operation, the first successful cases were those of Sidney Jones of London in 1874[1] and Verneuil in 1876 (July 25). The first cases in America were those of Maury of Philadelphia in 1869 and Jacobi of New York in 1874. Of the 207 cases collected by Gross up to 1884,[2] 167 were for cancer and 40 for cicatricial stricture. There were 61 deaths from the operation itself, a mortality of 29.47 per cent. Life was prolonged in the cases which recovered, on the average, about eighty-two days. Between 1884 and 1891

[1] *Lancet*, May 15, 1875.

[2] *Trans. Amer. Surg. Assoc.*, 1884.

there were 99 cases, as collected by Powers.[1] Of these, 83 were for cancer and 16 for cicatricial stricture. Death, as the result of the operation, occurred in 26 cases, a mortality of 26.26 per cent. The mortality at the present time is much less than formerly. Senn[2] estimates it at 25 per cent. I have found reports of 40 additional cases since 1892.

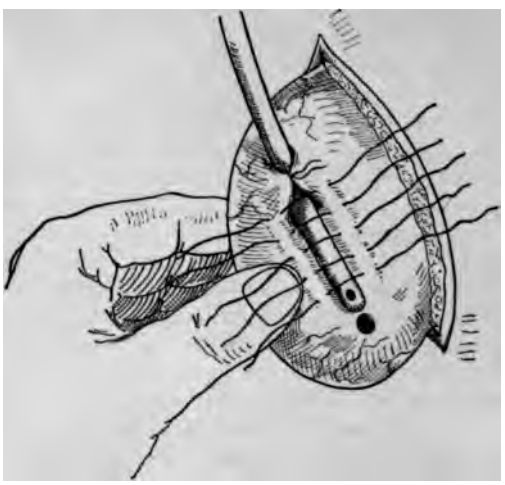
The indications for gastrostomy are generally clear. The operation is demanded when the passage of food to the stomach is so obstructed as to interfere seriously with nutrition, but it is advisable to make a gastric fistula much earlier than this. In fact, many authorities believe in performing the operation in cancerous stricture long before deglutition becomes difficult. The reason for this is obvious when we consider the great and rapid loss of strength which takes place as soon as the amount of food taken into the stomach is insufficient. The operation may be demanded in any or all of the lesions which prevent deglutition. The older methods of gastrostomy—Sedillot's and Fenger's—are now practically abandoned on account of the difficulty of preventing leakage from the fistula. By Sedillot's method, through a crucial cut in the left rectus the stomach was drawn out and held with a steel pin. The incision was sometimes made through the left linea semilunaris. Foster, Durham, and Verneuil, of the early operators, used this route. In Fenger's operation an incision was made on the left side parallel to the borders of the rib. Into this incision the stomach was stitched. Langenbeck and Krönlein in holding up the stomach made use of steel needles. The operation generally done within the last fifteen years has been that of Fenger, but it is now being abandoned for other methods.

Of the modern methods, Von Hacker's[3] consists of an incision through the left rectus. The cut is made across the fibres of this muscle for the purpose of producing an artificial sphincter. Yet in this method, as in many others, leakage is not always controlled. Myer[4] of New York reports 6 cases treated by this method, slightly modified: 3 cases died from the operation, 3 lived from three to eight and a half months. Girard[5] reports a very similar operation in which an attempt is made to form a sphincter from the fibres of the rectus. By Hahn's method,[6] first performed in 1887, the opening is made nearer the cardia, with the expectation of controlling more effectively the leakage. The stomach is exposed by Fenger's incision along the costal border. The eighth intercostal space is then exposed. A perforation is made through this space, out of which the stomach is drawn and fastened to the skin. According to the inventor of this operation, not only is the normal stomach easily accessible through the space, but the method is peculiarly practicable when the gastric wall is thickened and contracted. Coccherelli's[7] modification of this consists in a single cut over the eighth intercostal space, through which a fold of the stomach is drawn over the eighth rib. In 16 cases of gastrostomy for œsophageal cancer there was relief in 13, 1 case living two years after the operation. Up to 1890, Von Hacker had performed this operation 8 times: in 2 cases there was erosion of the rib as a result.

[1] *Internat. Journ. of Surgery*, Nov., 1891. [2] *Chicago Medical Recorder*, Jan., 1892.
[3] *Centralbl. f. Chir.*, 1891, 37. [4] *Amer. Journ. Med. Sci.*, Oct., 1894.
[5] *Wiener med. Presse*, 1889, No. 25. [6] *Centralbl. f. Chir.*, 1890, p. 193. [7] *Loc. cit.*

In Witzel's method[1] of gastrostomy leakage is prevented by making a long narrow fistula. This is accomplished by infolding a tube in the

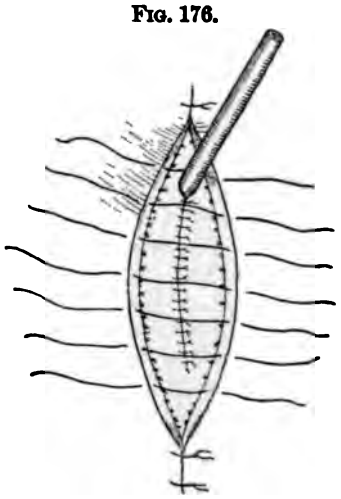
FIG. 174.



Witzel's method of gastrostomy: infolding the tube.

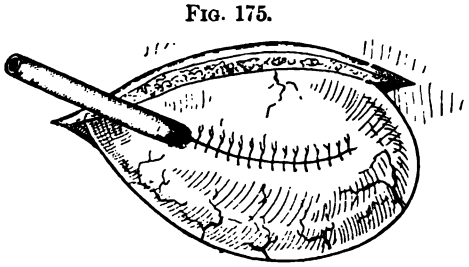
anterior wall of the stomach. By this method the stomach is opened immediately; in the others the opening is secondary. The operation has been frequently performed since its introduction and presents many advantages over all others. Successful cases have been reported by Mikulicz,[2] Keen,[3] Myer,[4] Tait,[5] and others. The technique of Witzel's operation consists in an incision either in the left linea semilunaris or parallel with the costal borders, out of which the stomach is drawn. A

FIG. 176.



Witzel's method of gastrostomy, showing the manner of fastening the stomach to the abdominal wall: sutures for closing the abdominal wound in place.

FIG. 175.



Witzel's method of gastrostomy: tube in place.

catheter or any suitable tube is then placed upon the presenting stomach-

[1] *Centralbl. f. Chir.*, 1891, p. 601.
[2] *Berlin. klin. Woch.*, 1893, No. 1.
[3] *Annals Surg.*, 1893, p. 638. [4] *Loc. cit.*
[5] *Pacific Med. Journ.*, June, 1894.

wall and infolded by interrupted stitches, the lax wall of the stomach being drawn through the wound and secured. The length of the infolding may vary, according to circumstances, from two to three inches.

FIG. 177.

Witzel's method, completed.

FIG. 178.

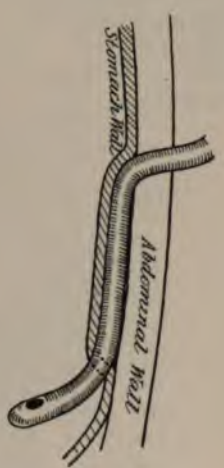


Diagram showing path of the tube in Witzel's method of gastrostomy.

The catheter is then thrust into the stomach through a small opening, which is itself then closed by two or three interrupted stitches. The tube now leaves the stomach-wall two inches or more from the seat of the perforation, these two or three inches being a water-tight canal filled entirely by the catheter. The stomach itself may be secured into the wound and the skin over the whole closed completely. The practical effect of this method is to make a sinus two or three inches in length, which collapses entirely on the withdrawal of the instrument, and prevents thereby any leakage whatsoever (Figs. 174–178). The tube should be left in two or three days in order that the parts may get well glued together. It should not be left out long at first, because there may be some difficulty in its reintroduction.

The Ssabanajew-Frank method was so called because it was done in 1890 by Ssabanajew of Odessa[1] and by Frank[2] in Vienna in 1892. By this method two incisions are made. The first is along the left costal border. The stomach is drawn out of this incision a sufficient distance and fastened there. A second incision is made through the skin an inch or two to the left. The tip of the gastric fold is brought under the skin and fastened into this second incision. The fistula is made at this point. Meanwhile the first incision is closed (Figs. 179–181). The inventors of this operation have reported each 4 cases, Myer of New York 3. This method is inapplicable in cases of contracted stomach. Indeed, in

[1] *Centralblatt f. Chir.*, 1893, p. 862.

[2] *Wiener klin. Woch.*, 1893, No. 13.

cases of prolonged starvation the stomach will not infrequently be found

FIG. 179.

Ssabanajew-Frank method of gastrostomy, first stage.

so contracted that it is brought with difficulty to almost any ventral incision. The method under consideration demands a lax stomach-wall.

FIG. 180.

Ssabanajew-Frank method of gastrostomy, second stage.

In all methods of gastrostomy care must be taken not to mistake the

colon for the stomach. This error has been made by several surgeons. There is generally no difficulty whatever in recognizing the characteristic appearances of the anterior wall. In most cases the stomach presents itself immediately at the incision if the latter is made well above the umbilicus, whether in the median line or to the left. The difficulties arising from contraction of the stomach in prolonged starvation may be great. In one or two instances in my own experience it has been almost impossible to draw the stomach into the abdominal wound. In such cases it may be out of the question to perform Witzel's or Hahn's operation, the only resource being to bring the surface of the stomach to the wound and to sew it there. The incision into the stomach may be made

FIG. 181.

Ssabanajew-Frank method of gastrostomy, completed.

immediately by all the methods: it must be made immediately by Witzel's. There is little objection to establishing the fistula at once if the peritoneum is tightly approximated to the wound. In many cases of gastrostomy for œsophageal stricture the patient has been starved so long that it is extremely desirable to feed him at once. The risks from opening the stomach are so slight in such cases that it seems desirable to make the opening immediately, in spite of the slightly increased risk. To open the stomach the cautery or knife may be used, the former preventing hemorrhage. Hemorrhage in gastric incisions is an unimportant factor, even if the cut is several inches in length. By the more recent methods of gastrostomy the complicated devices for preventing leakage are unnecessary. In those operations in which the stomach is simply fastened into the wound and opened the fistula in the course of time becomes so large and its depth so slight that there is not only extreme discomfort from constant leakage, but a considerable portion of food is lost during peristalsis. To prevent this various methods have been employed, among them rubber bulbs, one inside and the other outside of the abdominal wall. By inflation of these bulbs extravasation is prevented.

Unfortunately, the pressure upon the tissues between the bulbs rapidly enlarges the opening. Tampons also have been used. Warren of Boston demonstrated on dogs the possibility of making a valve at the end of the fistula by means of a fold of mucous membrane. The later methods described above are so satisfactory in restraining extravasation that this method need seldom be used—only, in fact, in those cases in which the stomach is so contracted that the modern operation cannot be performed.

In the after-treatment of gastrostomies the chief point is in feeding. If the stomach is not opened immediately, the patient must be nourished by rectal injections. The food can be introduced into the stomach just as soon as the fistula is made. Witzel's operation has this great advantage, that food and stimulants can be given immediately. If, as in most of the cases, no food has been received into the stomach for a long time, nourishment must be given cautiously and in small amounts. The feeling of hunger is assuaged by allowing the patient to masticate food before introducing it into the stomach. In all cases in which the food must be introduced through a tube it must be in liquid form. Ewald[1] discusses at length the digestive power of the stomach after gastrostomy. In cases performed for cicatricial stricture the digestive power of the stomach is not impaired. After gastrostomy for cancerous strictures he has observed great weakening of digestive function, due to the absence of hydrochloric acid and pepsin. He urges, therefore, the use of food which has been predigested, the main function of the stomach being simply that of a receptacle until the food can pass on to intestinal digestion. In the older methods of gastrostomy the difficulty was to keep the opening small; in the later to keep it open. To prevent closure the tube may either be left in a considerable part of the time, being occasionally removed for cleansing, or it may be introduced at regular intervals.

Loreta's Operation consists in digital dilatation of either orifice of the stomach after gastrotomy. It is applicable to non-malignant strictures either at the pylorus or at the cardia. This operation was first performed by Loreta of Bologna on September 14, 1882. In the majority of cases it is performed for stricture at the pylorus. Most of the operations have been done by Loreta himself. McBurney[2] has reported 2 cases; Barton[3] of Philadelphia has collected 25 cases done up to 1889, including 1 of his own.

The technique of the abdominal and gastric incision is the same as in gastrotomy for retrograde operations upon the œsophagus, except that the opening in the stomach should be near enough the pylorus to bring the disease within easy reach of the finger or the instrument. Unless bound down by adhesions, the pylorus should be drawn out of the abdominal wound to prevent as effectually as possible peritoneal contamination. The tip of the index finger of the right hand should be inserted carefully into the stricture and gently pressed onward until fully introduced. The index and middle fingers together should next be similarly used; finally, if possible without too much force, the stricture may be dilated to the extent of three fingers. In case the opening

[1] *Loc. cit.*

[2] *Annals of Surgery*, May, 1886.

[3] *Trans. Amer. Surg. Assoc.*, vol. vii. p. 97.

is too small for the insertion of one finger, preliminary dilatation may be employed by means of bougies or of divulsors. In malignant strictures Bernays has suggested the use of the curette at this stage of the procedure. As soon as the stricture has been dilated in this manner as thoroughly as seems safe, bearing in mind the dangers of laceration and of perforation, the cuts in the stomach and in the abdomen may be sutured in the way already described. (See Gastrotomy.)

Treves advises a vertical instead of a longitudinal incision. At times the pylorus will be found firmly bound down by adhesions, so that delivery through the wound will be impossible. In such cases the manipulations must be intra-abdominal. In some instances the pyloric orifice is very small. In a case reported by White and Lane[1] it admitted only a No. 4 catheter. In some cases, as in Hagyard's,[2] it is necessary to dilate the stricture with instruments before the finger can be introduced. Treves[3] mentions a case in which he could find no pyloric opening. The immediate risks of this operation are from hemorrhage and from rupture of the stomach, with extravasation. A remote disadvantage of this method—and, to most surgeons, a positive contraindication—is the probable recurrence of the stricture. Cicatricial contractions of the pylorus do not differ materially from those of the urethra or the œsophagus, in which a single dilatation, even if sufficient to restore the normal calibre, is always followed by a recurrence of the stenosis. Though some cases have been reported in which cicatricial stricture of the pylorus has been permanently benefited by Loreta's method, most surgeons report that recurrence is the rule. Moreover, the immediate risk which attends this operation is considerable. Paul Swain[4] reports 2 cases which resulted fatally—1 in five days from acute vomiting, the other in four hours from complete rupture of the stomach. In the latter case the stretching was said to have been much less than that advised by Loreta. In one case of my own[5] death followed in a few days from exhaustion. Senn[6] condemns the operation, and advocates pyloroplasty as the safer and shorter means of treating non-malignant stricture. According to Schroeter,[7] who also condemns the procedure, the mortality is about 46 per cent.

Resection of the cardia after gastrotomy has never been attempted on man. Levy[8] of Berlin reports some experimental work on dogs to demonstrate the possibility of such a procedure. He found the operation extremely difficult, and met with little success.

Pyloroplasty, first performed by Heinecke of Erlangen, and eleven months later by Mikulicz, and therefore called the Heinecke-Mikulicz method, consists in a longitudinal or a diamond-shaped incision in the anterior surface of the pylorus. The incision is carried not only through the tissues of the stricture, but into the normal structures of the stomach and duodenum. The resulting longitudinal wound is then sutured transversely (Figs. 182–184). The normal gastric and duodenal walls form the anterior surface of the pylorus, the tissues of the stricture the posterior. This method of treating benign pyloric strictures is justly regarded by most surgeons as safer and surer than that of Loreta. Senn[9]

[1] *Clin. Soc. Trans.*, 1891. [2] *Brit. Med. Journ.*, Feb. 19, 1887. [3] *Loc. cit.*
[4] *Lancet*, Jan. 9, 1892. [5] *Boston Medical and Surgical Journal*, Dec. 18, 1890.
[6] *Journ. Am. Med. Assoc.*, vol. xiv., 1890, p. 845. [7] *Deut. Zeits. f. Chir.*, 1894, p. 296.
[8] *Centralblatt f. Chir.*, Aug. 4, 1894. [9] *Loc. cit.*

reports 2 cases with recovery. Dreydorff[1] in an exhaustive review of operations upon the stomach collected 29 pyloroplasties performed up to

FIG. 182.

Pyloroplasty, incision.

1894, of which 23 were successful and 6 fatal. The average age of the patients was 35.35 years. The mortality by this method, only 20.7 per

FIG. 183.

Pyloroplasty, sutures in position.

cent., is much less than by any other. Doyen[2] of Rheims reports 3 cases with 2 deaths. He incised the pylorus in the axis of the lesser curvature.

The abdominal incision, the exposure of the field, and the precautions against extravasation are the same as in Loreta's operation. Over the seat of the stricture a longitudinal cut should be made extending in both directions through normal gastric and duodenal wall. The incision may be single and straight, or it may be in the shape of a diamond. By a diamond-shaped incision the anterior portion of the cicatricial tissue will be removed. Hemorrhage from the mucous membrane should be controlled by a continuous suture or by ligatures. The extremities of the

[1] *Beitrage zur klin. Chir.*, vol. xi. p. 333.

[2] *Lyons méd.*, July 13, 1892.

cut are brought together and sutured, the stomach being approximated to the duodenum. The longitudinal line is thus made transverse. If the resulting lumen is insufficient, the cut should be extended in both directions. The inverted peritoneal surfaces are fastened together as in

FIG. 184.

Pyloroplasty, sutures tied.

intestinal suture. The advisability of immediate closure of the abdominal incision, with or without drainage, will depend upon the contamination of the wound at the time of the operation and upon the security of the stitches.

After-treatment requires rectal alimentation, as in all operations upon the stomach. (See p. 272.)

Gastrectomy or Pylorectomy.—The term "gastrectomy" is applied synonymously with pylorectomy to resections of the pylorus. Gastrectomy, properly speaking, means removal of the whole stomach. Inasmuch as total extirpation of the stomach has been recently performed, the term gastrectomy should be limited to this operation. Resection of the pylorus for cancer was first suggested by Merrem in 1870. The first experimental work, however, was performed by Gussenbauer and Von Winiwarter, who showed that in animals partial resection of the stomach was possible. In 1878, Czerny and Kaiser removed without immediately injurious results the whole stomach from a dog. The dog lived eight months, losing half his weight. The first pylorectomy on man was performed by Pean[1] in 1879. The patient died on the fifth day. The second operation was by Rydygier in 1880; the patient died in twelve hours. The first successful case was that of Billroth's, Jan. 29, 1881. Dreydorff[2] gives the total number of pylorectomies up to 1894 as 188, with 10 additional cases of combined pylorectomy and gastro-enterostomy. Of the 188 pylorectomies, 80 recovered and 108 died. After the combined operation 4 recovered and 6 died. In simple pylorectomy the mortality was 74.07 per cent. The operation was performed on twice as many females as males. In 59 recoveries from pylorectomy the length of life after operation was from fifty days to three years, an average of eleven months and four days. The results in Czerny's cases at the Heidelberg Clinic are the most favorable, yet out of 45 cases of gastric surgery in this clinic up to 1894, 12 pylorectomies for cancer and 2 for benign stenosis give a mortality of 41.2 per cent.

[1] *Gazette des Hôpitaux*, 1879, No. 60.

[2] *Loc. cit.*

In one of Rydygier's[1] cases the duration of life after operation was two and a half years; in one of Kocher's, five years and four months. A case of Wölfler's lived over five years before recurrence.

Mikulicz reported at the Twenty-fourth Congress of German Surgeons (1895) the results of 103 operations on the stomach and pylorus—gastrostomies, gastro-enterostomies, resections of the pylorus, and pyloroplasties. Of these, 35 were operated on by Mikulicz at Krakau and Königsberg, 68 in Breslau. The mortality of the former series of 35 cases was 37 per cent., of the latter series of 68 cases, 15 per cent.

In 25 operations for non-malignant stricture of the pylorus there were only 2 deaths, of 73 for carcinoma, 16 deaths. The causes of death were collapse, pneumonia, inanition; in only 2 cases wound-infection. The operation for carcinoma prolongs life on an average about half a year, and gives great relief.

Mikulicz for improvement in his results in the future relies mainly upon progress in the methods of diagnosis, since he regards the present technique as perfect as is possible with our present knowledge. For purposes of diagnosis he recommends an incision of only two to four centimetres in length.

With the present improved technique the immediate risks of pylorectomy are considerably lessened. Out of Kocher's last 9 cases,[2] only 2 deaths resulted from the operation itself; of his last 6 cases of combined resection and anastomosis, none died from the operation.[3] Zeller[4] of Stutgardt in a collection of 117 cases of pylorectomy for malignant disease shows a mortality of 53 per cent. Billroth's statistics,[5] published in 1891, show that, of 41 cases, 29 were for malignant disease; of the latter, 13 recovered and 16 died. There were 12 for benign stricture; of these, 6 recovered and 6 died. The great mortality attending this operation is doubtless due in part to the unfavorable nature of the cases. If the operation is performed only for distinctly localized disease, in which resection and approximation are easy, the immediate mortality will doubtless be much less than that given above.

Pylorectomy is indicated in malignant and in benign growths strictly limited to the pylorus, and in cicatricial stenoses in which pyloroplasty, digital or instrumental dilatation, is impossible. Pylorectomy is contra-indicated in malignant stenoses when structures contiguous to the pylorus are involved or when remote metastases exist. If the growth, though confined strictly to the stomach, is so extensive that the resected ends cannot be brought together, pylorectomy combined with gastro-enterostomy may be performed. Cases of cancer in which a tumor can be felt through the abdominal wall are usually so far advanced that surgical interference offers no hope of permanent cure. Nevertheless, on exploration such cases may be found favorable for resection, whereas others, without perceptible tumor, may be totally unsuitable. One must be prepared, in all cases, therefore, for pylorectomy, for gastro-enterostomy, or for both.

The stomach and bowels should be made as empty as possible before

[1] *Wiener klin. Woch.*, March 8, 1894. [2] *Deut. med. Woch.*, April 18, 1895.
[3] Rydygier, *Wiener klin. Woch.*, March 8, 1894.
[4] *Wurtemburg Correspondenzblatz*, 1893, vol. lxiii. p. 26.
[5] *Wien. klin. Woch.*, 1891, vol. iv. p. 34.

the operation, the former by lavage, the latter by enemata. (See Prepa-

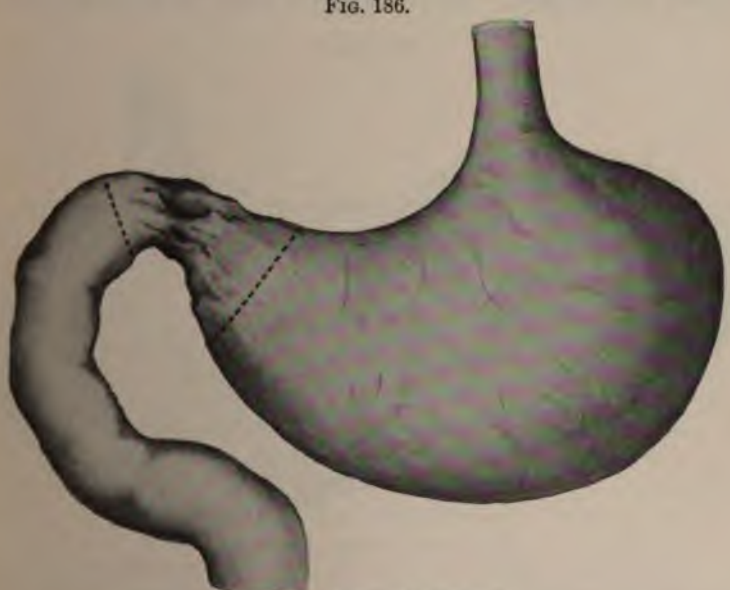
FIG. 185.

Pylorectomy, lines of excision.

ration for Operation on the Stomach.) Preliminary rectal feeding should be employed for forty-eight hours.

A small incision in the median line should first be made, through

FIG. 186.



Pylorectomy, lines of excision.

which, by digital exploration, the question of further interference may be decided. This cut should be enlarged upward and downward, to the

right or to the left, according to the operation determined upon and the seat, extent, and mobility of the disease. As in other operations upon the stomach, free delivery through the abdominal wound greatly simpli-

FIG. 187.

Pylorectomy, method of suture.

fies the technique. If the pylorus is bound down by adhesions so that delivery is impossible, the incision must be enlarged sufficiently to permit free access to the parts. In malignant disease, however, adhesions so

FIG. 188.

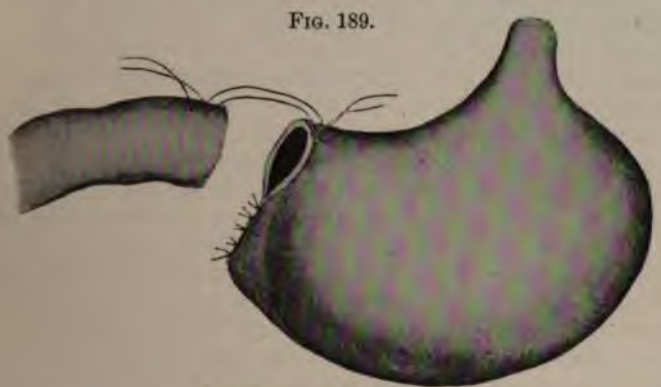
Pylorectomy, method of suture.

extensive as to prevent free delivery of the pylorus usually contraindicate operation.

Before excising the diseased tissue its extent should be accurately determined, and gauze barriers placed on all sides to absorb escaping gastric

fluids and to prevent peritoneal contamination. The stomach above and the duodenum below should be held firmly by the fingers of an assistant or by means of clamps or rubber tubing. The stomach and the duodenum should be cut transversely well above and below the disease, a margin of at least half an inch of healthy tissue being removed with the growth.

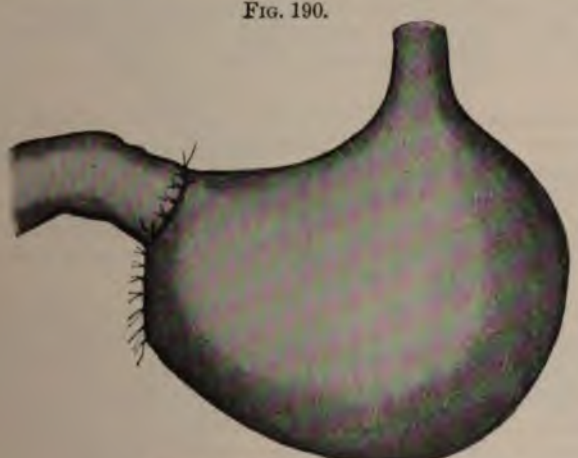
FIG. 189.



Pylorectomy, method of suture.

Hemorrhage must be controlled by the use of catch-forceps (Figs. 185, 186). The open ends of the stomach and the duodenum may be packed temporarily with gauze, though the procedure is not essential. Separation of the mass from its posterior attachments must be made with extreme caution to avoid wounding the inferior vena cava, the abdom-

FIG. 190.



Pylorectomy, method of suture.

inal aorta, or the cœliac axis. Scissors or scalpel may be used for this purpose, the bleeding vessels being secured as fast as they are cut. If the attachments are long and lax enough, a single ligature may be applied before excision is made. A very broad pedicle may be tied in sections. All bleeding having been checked by means of ligatures, the open ends

of the stomach and the duodenum should be fitted together and fastened by means of sutures. The gauze packed inside to prevent extravasation must not be forgotten. If the opening in the stomach exceeds very much that in the duodenum, the parts must be fitted together by plastic cuts until they can be brought into easy and satisfactory approximation. Large transverse openings in the stomach may be reduced in size to fit the duodenum by the application of sutures at the upper or at the lower extremity of the cut, or at both. When the cut is extensive and irregular the sutures must be applied as the shape and size of the opening suggest (Figs. 187–190). The method of suture best adapted to this operation is the interrupted Lembert, for better than any other method it combines speed with safety. One or more rows of stitches may be applied. The chief danger in this, as in all methods of intestinal suture, is that of extravasation. Hence in pylorectomy it is desirable to provide for possible extravasation by strands of sterile gauze which, applied to the line of suture, lead directly out of the abdominal wound. Provisional sutures left in the external wound may be tied after removal of the gauze, which should remain two or three days. Rectal feeding is a most important element in after-treatment. Nothing should be taken by the mouth for three or four days. (See After-treatment in Operations on the Stomach.)

When it is impossible to bring the open ends of the stomach and the duodenum together, each must be permanently closed and an outlet must be provided between the stomach and the intestine. This method, known as "combined pylorectomy and gastro-enterostomy," has proved so successful that it is urged by some as a substitute for simple pylorectomy, even in those cases in which the stomach and the duodenum can be easily united. Bull has had success with this method. It is advised by Hahn,[1] by whom one case is reported which lived for three and a half years after operation. The method is also recommended by Braun.[2]

The statistics of combined cases are more favorable than those of simple pylorectomy, though Dreydorff gives 10 operations performed up to 1894, of which 6 were fatal—a mortality of 66 per cent. On the other hand, Rydygier[3] reports 6 cases, all successful. The immediate mortality of this method is lower than that of pylorectomy, because of the increased rapidity with which it may be performed, especially if mechanical aids are used.

Gastro-enterostomy is an operation devised for carrying on nutrition in those cases of pyloric stenosis, malignant or benign, in which pylorectomy, pyloroplasty, or dilatation is impossible. The alimentary current, diverted from its normal channel, passes directly into the jejunum. This operation is indicated most frequently in malignant stenoses; rarely in those of a cicatricial or benign nature. Gastro-enterostomy was first performed by Wölfler. The early methods of gastro-enterostomy —Wölfler's, Rockwitz's modification, and Von Hacker's—depended entirely upon the use of sutures. The introduction of mechanical aids has materially modified the technique, especially with reference to speed.

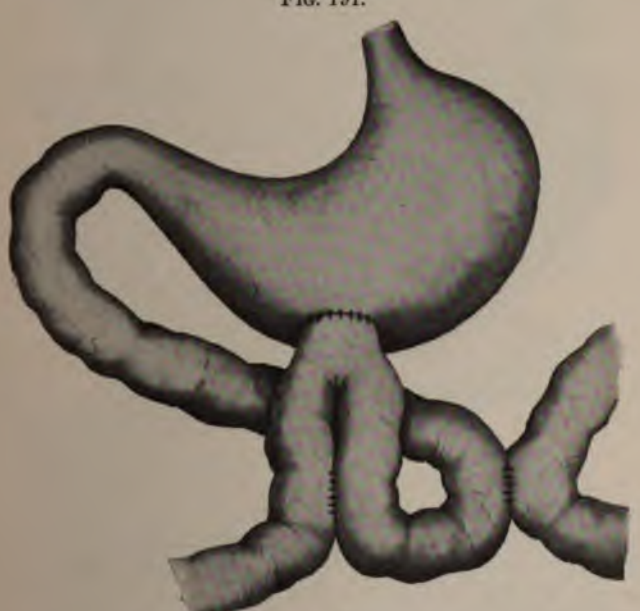
By Wölfler's method the jejunum is united to the anterior wall of the

[1] *Deutsch. med. Woch.*, Oct. 25, 1894.
[2] *Archiv f. klin. Chir.*, vol. xlv. p. 350, 1893.
[3] *Loc. cit.*

stomach by interrupted silk sutures. The incision into the stomach is about three inches in length, in the anterior wall near the greater curvature; that in the jejunum of similar length in its anterior and upper surface. By this method the peristaltic action of the intestine is in a direction opposite to that of the stomach, a combination resulting not only in the retention of food in the stomach, but in vomiting and other gastric disturbances. Rockwitz's modification consists in twisting the anastomotic loop of intestine half round on itself before uniting it with the stomach. Yet this device does not overcome the difficulty. It remained for Von Hacker to solve the problem. By his method, suggested also by Courvoisier in 1883, the jejunum is united to the posterior wall of the stomach, the omentum and the transverse colon remaining intact. When the posterior wall of the stomach is bound down by adhesions, this method is impracticable.

By the use of Senn's plates, the Murphy button, and other mechanical devices the time necessary for the performance of this operation has been greatly shortened. Greater speed is certainly possible in the application of the Murphy button; greater safety, in that of the plates of Senn. In some cases the pressure-necrosis produced by the Murphy method extends beyond the margin of the button and produces a fatal extrava-

FIG. 191.



Braun's method of multiple anastomosis.

sation—an accident that happened recently after one of the operations performed by the writer. This complication cannot arise after the use of Senn's plates. Moreover, the button may become impacted lower down in the intestine, especially if the size employed is great enough to ensure in successful cases a permanent anastomosis. Nevertheless, the

use of the Murphy button greatly shortens and simplifies the technique, and the joint is for the time being absolutely perfect. If with additional experience fatal extravasations can be avoided, Murphy's method will be invaluable.

Gastro-enterostomy should be performed through a median incision above the umbilicus long enough to permit free inspection and manipulation. It is desirable, if possible, to draw both stomach and jejunum out of the abdominal wound. The incision into the stomach and into the jejunum should not be less than two inches in length. The posterior edges of the cut should first be sutured together, the line being thence continued forward till the whole margin is included. For greater security a second row may be applied outside the first. The technique of applying Senn's plates or the Murphy button is precisely like that used in intestinal anastomosis, and will be described under that head.

Combined Methods of Anastomosis.—A disadvantage common to all the above methods of gastro-enterostomy is the stagnation of food and intestinal secretions in the unused portion of the jejunum and of the duodenum. Even necrosis of the bowel may take place, as in the second gastro-enterostomy ever performed. In 10 cases operated upon by Wölfler's method regurgitation of bile and uncontrollable vomiting ensued. At the autopsies the unused part of the intestine was found full of food. In view of these difficulties, Braun made use of one or

FIG. 192.

Sonnenberg's method of gastro-enterostomy, first step.

two additional anastomoses between the intestinal loops, as in the method first suggested by Lauenstein in 1891 (Fig. 191). Braun reports 5 operations of this kind, with 3 recoveries. At the autopsies of the 2 fatal cases, which died on the tenth and sixteenth days, respectively, after ope-

ration, the method was found to have accomplished its object—namely, the emptying of the duodenum.

Another method is that of combined section and anastomosis, as given under the head of Pylorectomy and Combined Methods. This procedure can be modified by dividing the jejunum completely, the lower end being inserted directly into the stomach, the upper closed.

Sonnenberg's method, recently reported by Schroeter,[1] is as follows: To the edges of the gastric incision catgut sutures with long ends are fastened at intervals of a few millimetres. The incision in the jejunum is next sewed over and over by a continuous catgut stitch. The long

FIG. 193.

Sonnenberg's method of gastro-enterostomy, second step.

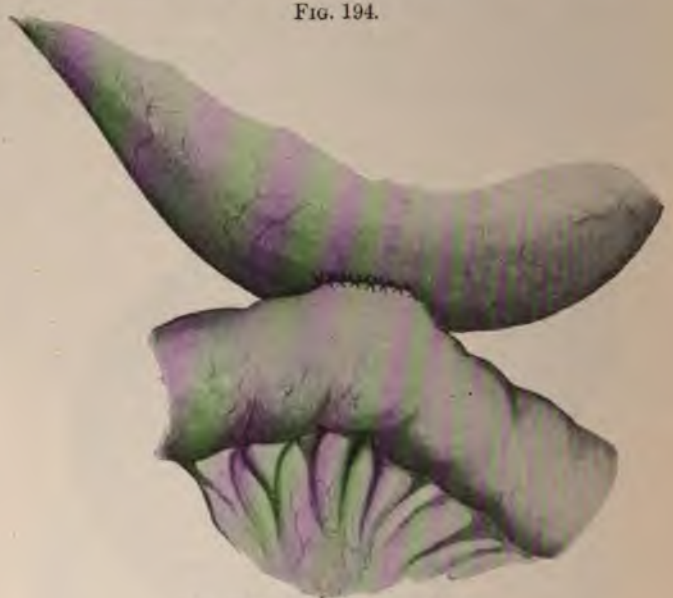
ends of the gastric sutures are then passed into the jejunal opening and brought out through a cut made a short distance farther in the intestine. Traction upon these ends draws the stomach into close approximation with the jejunum, where it is securely fastened by sutures through the peritoneum. The method is not dissimilar in principle to Maunsell's invagination suture of the intestine. For additional security a second row of sutures may be applied. No results are given (Figs. 192–194).

Statistics of Gastro-enterostomy.—In Dreydorff's total of 442 cases of stomach surgery done up to 1894 are included 215 gastro-enterostomies. Of this number, 122 recovered and 93 died—a mortality (43.4 per

[1] *Deut. Zeitschrift f. Chir.*, 1894, p. 296.

cent.) much less than that of pylorectomy. Out of 23 gastro-enterostomies done at the Heidelberg clinic up to 1894, the mortality was only 39 per cent. The proportion of men to women was as three to two in gastro-enterostomy, whereas pylorectomy has been performed on twice as many women as men. Several observers have noticed that men come

FIG. 194.



Sonnenberg's method, completed

later to operation than women. Zeller[1] gives statistics of 152 cases of gastro-enterostomy, all performed by suture methods, with a mortality of 43.5 per cent.; Rydygier[2] gives a mortality of 4 out of 17 in Lauenstein's cases operated on by recent methods.

The comparative mortality of gastric anastomoses performed by the suture method and by mechanical aids show a great percentage in favor of the latter. The mortality by Dreydorff's statistics is 43.4 per cent. in 215 cases; in Zeller's, 43.5 per cent. in 152 cases; in Billroth's, 50 per cent. in 28 cases up to 1891; in Rockwitz's, 57.7 per cent.; 21 cases operated on by Wölfler's method had a mortality of 47 per cent. This high mortality of suture methods is in strong contrast to that after the use of plates. Magill[3] found a gross mortality of 22.95 per cent. in 61 gastro-enterostomies performed from 1887 to 1894 by the aid of mechanical devices.

Gastrorrhaphy is an operation devised to reduce the size of a greatly dilated stomach. So far as found, this operation has been performed by only two surgeons, Bircher and Weir. Bircher[4] reported 3 cases of enormous dilatation in which he had folded a plait into the stomach, sewing the peritoneal surface so as to retain the fold. Weir[5] reported a similar

[1] *Loc. cit.* [2] *Loc. cit.* [3] *Annals of Surgery*, Sept., 1894.
[4] *Correspondenzblatt f. Schweizer Aertze*, Dec. 1, 1891.
[5] *New York Med. Journ.*, July 2, 1892, and *Trans. Amer. Surg. Assoc.*, vol. x.

case in which he took a double tuck in the stomach, an operation which was very successful. Weir concludes that this method can be applied with success to those cases of chronic dilatation of the stomach which are not much benefited by lavage.

Operations for Painful Gastric Adhesions.—One of the complications or results of gastric ulcer is a possible gastralgia, resulting from the formation of adhesions. If, after the healing of an ulcer of the stomach, the general health improves, but pain persists, the possibility of the existence of adhesions should be borne in mind. Operations for the separation of such adhesions have been performed several times with brilliant results. Landerer[1] of Leipsic operated on 3 cases of obstinate and intense gastralgia, which had been treated for months as neuroses. In 2 cases adhesions between the stomach, the parietal peritoneum, or the liver were found, the freeing of which caused the pain to cease. Terrier[2] reports 2 successful cases of this kind; Lucas Championnière,[3] a third.

Gastro-anastomosis for hour-glass contraction of the stomach was first performed by Wölfler.[4] Another case is reported by Eiselberg.[5] Watson of Boston has recently operated with brilliant success upon a case of hour-glass contraction of the stomach.[6] The patient, a woman of thirty-two, was reduced to the last degree in strength and weight. An anastomosis was made between the two portions of the stomach after folding the pyloric extremity over and upon the cardiac. The surfaces thus brought in contact were first successfully sutured. The anastomosis was then made through an incision in the presenting wall of the distal portion. The anterior incision was then closed. The patient made a perfect recovery, and was shown by Watson at the January meeting of the Surgical Society of Boston in 1896.

Surgery of the Intestines.

Contused Wounds and Ruptures of the Intestine.—Serious injury to the intestine may be caused by violent blows upon the abdominal wall, even if the parietes are not penetrated. The force of the blow affects chiefly the distended coils, and, as a rule, only those coils directly contiguous to the point of impact. Rupture of the intestine follows most frequently a kick in the abdomen from a man or a horse or is produced by the passage over the body of a heavily-loaded cart. It may result from sudden violent blows of any kind. The injury may be confined to the inner coats of the intestine, or it may involve them all and produce complete rupture. The laceration may be slight or extensive, single or multiple; a coil may be completely torn in two. In a recent case (July, 1895) at the Massachusetts General Hospital, Elliot found a linear tear of the duodenum with rupture of the stomach caused by the kick of a horse. There was an extensive extravasation of blood in the retroperitoneal tissues. The writer once repaired unsuccessfully an extensive laceration of the small intestine caused by the kick of a man. At the Harvard Medical School, in a

[1] *Muencheuer med. Woch.*, Sept. 26, 1893.
[2] *Revue de Chir.*, Nov. 10, 1894.
[3] *Ibid.*
[4] *Beitrage zur klinische Chirurgie*, xiii. 1, 1894.
[5] *Arch. f. klinische Chirurgie*, Bd. 50, p. 923.
[6] *Boston Med. and Surg. Journ.*, April 2, 1896.

dissecting-room subject in which there was no evidence of external injury, the intestine was found torn in every direction; the spine was also extensively comminuted. The man had been caught between the dead-woods of two freight-cars.

The chief danger in intestinal rupture results from fecal extravasation. When the opening is small the intestinal contents escape slowly and in small amounts, especially if the bowel is not distended or if the fæces are solid. This is the most favorable form of rupture, for adhesive peritonitis may immediately close the opening and prevent a general infection, particularly when fecal escape is retarded by eversion of the mucous membrane through the laceration. A spontaneous cure is sometimes effected in this way. In extensive lacerations into the lumen fecal contents escape more or less rapidly according to the amount of distention, the fluidity of the intestinal contents, and the situation of the opening. If the rupture is in the large intestine, containing hardened fæces only, extravasation will generally be slow and limited; if in the small, distended with liquid fæces, it will be rapid and extensive. Unfortunately, the force of the blow usually expends itself upon the distended rather than upon the collapsed coils, so that extensive and fatal extravasations are the rule.

The **symptoms** of rupture of the intestine are—first, those of shock from the violence of the blow itself; and, secondly, those from the immediate results of septic extravasation. If the rupture is slight and if fecal escape is prevented by rapid adhesion-formation, no secondary symptoms of peritonitis will appear. The immediate symptoms of shock and collapse, if the rupture is complete, are followed by those of rapidly-spreading general peritonitis.

The **diagnosis** of rupture with slight extravasation depends upon the history and upon local pain and tenderness. The constitutional symptoms are usually slight and transitory, though they may be severe and lasting. The symptoms of systemic depression soon disappear, however, though pain and tenderness persist until the localized peritonitis has subsided. If the rupture is extensive or fecal escape abundant, the systemic depression is more marked and the infection more general. The patient is collapsed, the abdominal muscles are rigid, the temperature subnormal, and the pulse rapidly rising. These symptoms are quickly followed by reaction in the constitutional signs. The temperature rises; the abdomen rapidly distends; tenderness, at first local, becomes general, and in the course of a few hours the symptoms of general peritoneal infection are conspicuous.

The most important symptoms in this accident are those by which we may recognize the nature of the lesion at the earliest possible moment, for the remedy in complete ruptures, to be of avail, must be applied in the first few hours of the extravasation.

From the numerous cases of intestinal rupture reported from time to time it appears that the **prognosis** in complete ruptures is always grave; for by the time surgical aid can be applied the peritoneum is so widely infected that the patient is generally beyond relief. When the fecal escape is slight the prognosis is less serious.

When rupture of the intestine is suspected, the **indications for operation** are found chiefly in the local abdominal symptoms, for general

systemic depression (shock) not infrequently follows severe abdominal contusions in which the intestines are uninjured. Local pain and tenderness, with muscular rigidity, nausea, and vomiting, following immediately upon a blow in the abdomen, demand immediate exploration even if shock is slight or absent. In the majority of such cases some serious lesion will be found. General pain, tenderness, and distention, with vomiting, obstipation, and fever, also demand abdominal section, though the outlook is gloomy. Dulness in the flank from serous or hemorrhagic effusions is an additional justification for interference.

Unless the signs point definitely to some particular spot, the incision should be made in the median line, either above or below the umbilicus, according to the seat of the blow and the preponderance of the local signs. The escape, the moment the peritoneum is nicked, of fluid from the abdomen demonstrates the existence of some serious lesion, even if the fluid is clear and colorless. If it is turbid and fecal, intestinal rupture is evident. To determine as accurately as possible the seat and the extent of the lesion without handling the intestines more than is absolutely necessary, the incision should be made long enough to permit easy inspection. If the source of infection cannot thus be ascertained, the intestinal coils must be examined in regular order until the seat of injury is demonstrated. Usually, however, detection of the lesion is easy.

The **treatment** of the injured bowel depends upon the nature and the extent of the rent. Small openings and linear tears may be closed by inverting the peritoneal edges and suturing; extensive lacerations, with bruising, may require partial or even complete resection. When neither resection nor suture is possible, the gut may either be sewed into the abdominal wound or packed about with gauze. Whatever the operation demands must be done with as little delay and as little exposure of the bowel as are compatible with thoroughness. The patient's condition in some instances will be so alarming by the time the lesion is found that it will be necessary hastily to fasten the injured bowel to the abdominal wound or to pack the parts with gauze.

More important than the technique of repair in these cases is the cleansing of the peritoneal cavity after extravasation. Let the suture be never so perfect, if the peritoneum is not most carefully cleansed a general peritonitis will usually result. The whole abdominal cavity should be inundated with warm saline solution, a procedure which not only removes the infecting material, but strengthens the circulation. After the use of gallons, if necessary, of this solution, the dependent places must be dried thoroughly with sterile gauze. After this, as after all septic abdominal operations, especially intestinal suture, the external wound should not be closed. Gauze wicks should be left in various places, and the line of suture protected by the same material against possible giving way of the stitches. When the local and constitutional signs are so slight that exploration is not indicated, the patient must be carefully watched for some time, since the damage to the intestinal wall, though causing no alarming symptoms, may be extensive enough to result eventually in a necrosis through which in the course of a few days there may be a burst of liquid fæces.

(For perforation of the intestine by typhoid ulcers, tuberculosis, and cancer, and for the treatment of fecal fistulæ, see subsequent sections.)

INTESTINAL OBSTRUCTION.—Intestinal obstruction, used synonymously with intestinal occlusion, intestinal strangulation, and ileus, is one of the most important abdominal conditions requiring surgical interference. Leichtenstern,[1] from a consideration of 1134 hospital cases, shows that, excluding hernia and malignant disease, 1 death in from every 300 to 500 is due to intestinal obstruction in some form. Fagge[2] found in 4000 autopsies 54 deaths from this cause.

Intestinal obstructions may be divided into the acute and the chronic. The acute cases come on suddenly, generally without previous symptoms. The chronic are slow in their development, and are usually due to stenosis from some form of organic disease. Many acute obstructions, however, develop suddenly in the course of chronic diseases in which obstructive symptoms have been subordinate and unsuspected. Such obstructions occur most frequently in the course of intestinal cancer, though they are occasionally met with in tubercular and syphilitic disease, in the contractions of diphtheritic, dysenteric, or typhoid ulcerations, or in the mechanical occlusions of benign tumors, such as polypi and lipomata. Acute obstructions, not the result of organic disease of the intestinal wall, depend upon some mechanical cause by which the lumen is obliterated. Complete atresia of the intestine may be the indirect result of congenital malformations by which internal strangulation takes place, as in the pressure of a Meckel's diverticulum or in the impaction of the gut in a foramen in the mesentery or in the omentum or in an anomalous pouch. Bands, congenital or acquired, may, under certain conditions, cause obstruction either by direct pressure across the intestine or by the strangulation of an entire coil. Faulty adhesions not infrequently produce kinks or sharp bends which result in a stoppage as effectual as that from any other cause. Such adhesions may occur in the course of ectopic gestations, of pelvic and other inflammations, especially appendicitis, and as the result of laparotomies. Volvulus and intussusception necessarily cause complete obstruction. Among the rarer causes may be classed the impaction of gall-stones, enteroliths, intestinal worms, foreign bodies, and hardened fæces. In rare instances complete stenosis results from the pressure of tumors, especially when situated in the pelvis.

The commonest form of acute obstruction, however, occurs without mechanical obstacle, the fecal stream becoming stagnant from paralysis of peristaltic action. This form of obstruction is seen most frequently in general peritonitis, though it may result from injuries and other causes.

(Obstructions from hernia are considered elsewhere.)

CONGENITAL MALFORMATIONS OF THE INTESTINE.—Although congenital malformations of the intestine above the anus and rectum are rare, they may play an important rôle in the production of acute and chronic intestinal obstruction; the possibility of their existence must therefore be borne in mind.

Malformations of the small intestine may be atresiæ, constrictions, fistulous communications, true and false diverticula, and, rarely, double intestine. In nearly all the cases the explanation of the malformation

[1] *Von Ziemssen's Encyklopädie*, American trans., vol. viii.

[2] *Guy's Hospital Reports*, 1869.

will be found in the condition of the omphalo-mesenteric remains. Malformations of the ileum are largely in excess of malformations of any other portion of the small intestine, because of the relation of the vitelline duct to the ileum.

Deformities of the ileum may be divided into two classes—the first caused by defective closure of the vitelline duct, the second by excessive closure. Incomplete closure of the vitelline sac may result in a communication between the umbilicus and the ileum, either a direct fistulous opening into the ileum, a tubular prolongation, or a fibrous cord. The last, varying in length, may connect either the intestine or the mesen-

FIG. 195.

Malformation of the intestine from a child: two portions of the intestine parallel within the same fold of the peritoneum, and quite distinct except for a small opening at one point (Warren Museum).

tery with the umbilicus. A Meckel's diverticulum of varying length may exist, terminating in a rounded extremity, single or double, or terminating in a fibrous cord attached to the abdominal wall or to a coil of intestine or floating free in the abdominal cavity.

Excessive closure of the duct may cause constriction of the ileum, marked or slight, total occlusion by a septum of mucous membrane, or complete solution of the continuity.

Davies-Colley[1] has reported a case of complete occlusion of the ileum by membrane; Theremin[2] has reported 7 similar cases. Atresia of the ileum has been reported by Bland Sutton and by Hobson.[3] Membranous occlusions and constrictions of the duodenum and jejunum do occur, though they are much rarer than such conditions in the ileum, and cannot be explained by the omphalo-mesenteric theory. Willett[4] reported a case of obliteration of the lower part of the duodenum, and also a

[1] *Path. Soc. Trans.*, vol. xxix. p. 115.
[2] *Deut. Zeitschrift f. Chir.*, 1877.
[3] *Path. Soc. Trans.*, vol. xxxvi. p. 217.
[4] *Ibid.*, 1894, p. 78.

case of atresia at the junction of the jejunum and ileum. Turner[1] reports a case in an infant of membranous closure of the jejunum.

The existence of a double small intestine, as illustrated in the drawing of a specimen from the Warren Museum, is very rare (Fig. 195). No literature on the subject has been found.

Diverticula of the intestine may be true or false.[2]

Meckel's diverticulum is the true form, and is found in about 2 per cent. of the subjects (Figs. 196–198). As stated above, it results from defective closure of the vitelline duct. In 2 cases at the Massachusetts

FIG. 196.

Internal strangulation by a diverticulum (Warren Museum).

General, in which the writer had made a diagnosis of acute appendicitis, an obstruction was caused by Meckel's diverticulum. In the first, operated upon by Elliot,[3] a large diverticulum, distended and gangrenous, was found. The second case was successfully operated upon by Mixter. Parise[4] claimed to be the first to recognize Meckel's diverticulum as a cause of intestinal obstruction. His claim has been denied by others, especially Leichtenstern. Cazin[5] has collected 30 cases of strangulation by diverticula, in 25 of which the tip was adherent. In a case of McGill's[6] the tip of a Meckel's diverticulum was adherent to the bladder.

[1] *Path. Soc. Trans.*, vol. xxxviii. p. 145.
[2] Osler, *Annals of Anatomy and Surgery*, 1881.
[3] *Boston Medical and Surgical Journal*, 1894, No. 24, p. 587.
[4] *Bull. de l'Acad. de Méd.*, 1851, p. 373.
[5] *Thèse de Paris*, 1862.
[6] *Brit. Med. Journ.*, Jan. 14, 1888.

Beach has operated successfully upon a diverticulum communicating with the bladder (Massachusetts General Hospital, Oct., 1895). In some cases the diagnosis of acute intestinal obstruction has been erroneously made in a general peritonitis from perforation of Meckel's diverticulum. Doran's case of perforation by a pea is an instance of this.[1]

False diverticula of the intestine are hernial protrusions of the mucous membrane through the muscular coats. They are always small

FIG. 197.

Small intestine having a diverticulum at the line of attachment and passing into the mesentery (Warren Museum).

FIG. 198.

Intestinal diverticulum (Warren Museum).

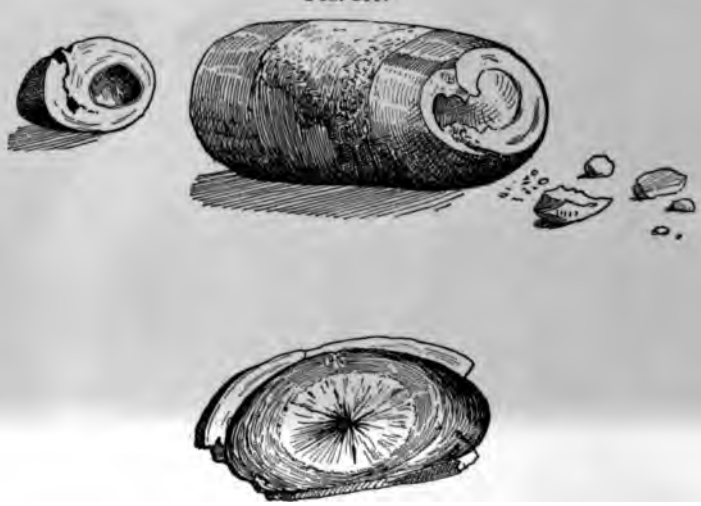
and are of little surgical importance, save from the possibility of their perforating, and from their being, in exceptional cases, confused with the vermiform appendix in operations. Edel[2] has reported 2 cases of multiple false diverticula found in old persons. In 1 case the diverticulum was very near the vermiform appendix—a position which might have caused confusion. It is not uncommon to find, at post-mortem examinations, multiple false diverticula which have caused no symptoms during life.

OBSTRUCTION FROM IMPACTION OF FOREIGN BODIES, GALL-STONES, AND ENTEROLITHS.—Foreign bodies which successfully pass the œsophagus and the pylorus seldom get impacted until they reach the anus. Now and then, however, the impaction takes place somewhere in the course of the small or the large intestine, especially in the case of sharp,

[1] *London Path. Soc. Trans.*, vol. xxiv. p. 122.
[2] *Vir. Archiv*, 1894, vol. cxxxviii. p. 347.

irregular, or elongated bodies. Foreign bodies introduced through the mouth may obstruct the lumen of the intestine by their size or by the inflammatory action which their presence excites. They may be arrested by already existing strictures or the irritation caused by their impaction may result ultimately in an inflammatory stenosis. With reference to the size of a body that can pass through the intestinal canal, Senn,[1] after numerous experiments, concluded that a body large enough to fill completely the lumen of the small intestine will be passed without difficulty if no change is caused in the wall of the intestine. Nevertheless, bodies considerably smaller than the lumen of the small intestine occasionally cause fatal impaction. Fig. 199 represents the

FIG. 199.



Enterolith of gall-stone origin removed by operation

actual size of an enterolith that caused complete obstruction to the small intestine, although of considerably less diameter than the distended bowel above it. The intestine was tightly contracted about the calculus; below, it was collapsed; above, distended. The patient, a vigorous man of seventy, had had the symptoms of obstruction forty-eight hours. His general condition was bad, and he died within twelve hours of the operation. Doubtless the mucous membrane had undergone some change by which the passage of the stone was prevented, though no such change was observed. The cause of impaction seemed to be the muscular contractions of the circular fibres, by which the object was immovably grasped. Whatever the truth may be with reference to rounded bodies, those with sharp edges and with angles may be arrested at any point. At times they make their way out by ulceration through the abdominal wall. Poulet mentions a number of extraordinary examples of this kind.

Enteroliths formed about gall-stones are the bodies which most frequently cause acute obstruction. Two fatal cases of impaction from enteroliths of this description have come under my notice—the one

[1] *Trans. Congress American Phys. and Surgeons*, 1888.

alluded to above and one of Mixter's occurring in an old woman subsequent to an attack of prolonged biliary colic. In the latter case operation was refused, and after death the stone was found impacted in the large intestine.

Genuine intestinal concretions, according to Leichtenstern, occur in less than 2 per cent. Enteroliths consist chiefly of phosphates, combined with animal matter, or they may be entirely vegetable in structure, mixed with more or less fecal matter. Treves mentions as avenolites, or "oat-stones," the concretions frequently found in Scotland, where coarse grain diet is common. Enteroliths may be composed of medicinal substances, such as benzoin, chalk, or shellac. A number of instances of obstruction by concretions have been recorded, among them the case of Aberle, quoted by Senn, in which the obstruction was caused by thirty-two enteroliths, each with a cherry-stone for a nucleus. Virchow reported a similar case. A fatal case of concretion formed from shellac was reported by Friedländer.[1] Langenbeck[2] showed a large number of concretions formed from derivatives of the biliary acids. Enteroliths of mineral origin, as stated by Leichtenstern, are heavy, stone-like bodies built up in layers of different shades of brown from a centre which is usually light-colored. These bodies are found generally in the cæcum or in pouch-like diverticula of the large intestine; they are found rarely in the small intestine. In the older literature of this subject gall-stones were supposed to be enteroliths. In my own case, reported above, the body was supposed to be of fecal origin until its section was made. A cross-section, however, showed the radiating crystals of gall-stone cholesterin which made up the nucleus of the body.

Leichtenstern[3] in 1553 cases of intestinal obstruction found only 41 caused by gall-stones. Courvoisier[4] found 131 cases of obstruction from this cause. Treves speaks of 30 cases, and Wising of 50. Roth[5] collected 65 cases. I have been able to collect up to the present time 149 cases of obstruction from gall-stones and from enteroliths, of which 133 were the former and 16 the latter.

Obstruction from gall-stones usually occurs in old women. In Leichtenstern's cases 32 were women and 9 were men; in Wising's cases 33 were women and 11 were men; in Treves's, 4 were women and 1 was a man; in Courvoisier's, 71 were women and 31 were men. Of 149 cases, 80 per cent. were women. Old age predisposes to this condition. The youngest of the 149 cases was forty-seven, the oldest ninety. Courvoisier found 6 cases under the age of forty. In Courvoisier's 131 cases, 70 recovered spontaneously after very severe symptoms from the passage of the stone, 3 recovered after operation, and 52 died. Out of Treves's 20 cases, 6 recovered spontaneously and 14 died. Wising had 38 deaths in 51 cases. In 149 cases I find 47 treated by operation; 24 cases operated upon in 1879–90 show a mortality of 70 per cent.; 23 cases from 1890–95, 52 per cent. In Koerte's cases the largest stone was 5 cm. long, 2.6 cm. thick, and 7 cm. in circumference. In one case the stone was as large as an English walnut.

[1] *Berlin. klin. Woch.*, 1882, No. 1.
[2] *German Surg. Congress*, 1880.
[3] *Von Ziemssen's Handbuch der Spec. Pathologie und Therapie*, vol. vii. Hefte 2.
[4] *Beiträge zur Pathologie und Chirurgie der Gallenwege*, 1890, Leipzig.
[5] *Langenbeck's Archiv f. klin. Chir.*, vol. xxxii. p. 120.

It is often difficult, if not impossible, to demonstrate the way in which these large calculi get into the intestine. 51 autopsies, however, show the following facts: in 33 there was evidence that there had been, or that there was, a fistula established between the gall-bladder and the duodenum of sufficient size to allow the passage of the stone. In 3 cases the common bile-duct had been sufficiently dilated to admit a finger, there being no fistula present. In 1 case there was a gall-bladder-stomach fistula,[1] and in 1 a gall-bladder-colon fistula.[2] In 14 cases this region was not explored or was found to be normal.

From a carefully-examined series of these cases Roth concluded that the fistula is generally located in the upper part of the duodenum, about 5 cm. below the opening of the common bile-duct. This duct almost invariably remains pervious. Few stones large enough to cause obstruction come from the duct. Between the gall-bladder and the intestine adhesions may undoubtedly form, through which in the course of time the calculus makes its way by an ulceration so slow as to give rise to no prominent symptoms. Courvoisier, out of 36 closely-studied cases, found only 3 in which the stone came through the duct. In the other cases there was evidence at autopsy to show that the stone made its way into the intestine by ulceration. In one of Koerte's cases the time of perforation was shown by the occurrence of a severe duodenal hemorrhage. In the 4 cases reported by him the usual history of gall-stone was absent, the only symptom noticed being a vague pain in the abdomen. In some instances marked signs of inflammation of the gall-bladder have been observed.

From the evidence which the cases under consideration present, it is hard to tell how long the stone has remained in the intestine or how long it may remain. In Koerte's case the first symptom, duodenal hemorrhage, occurred three months before the patient's death. It is probable, therefore, that in this case the stone remained in the intestine about three months. In general it is impossible to ascertain the length of time between the escape of the stone from the gall-bladder into the intestine and the initial symptoms of obstruction. The exact location of the impacted calculus has been determined in 83 instances either by autopsy or operation, the result of which is shown by the following table:

Duodenum	1
Jejunum	13
Upper ileum	5
Lower ileum	50
At ileo-cæcal valve	10
Colon, hepatic flexure	1
" sigmoid flexure	3

In many instances a stone impacted at the anus has been removed after having been the source of more or less trouble.

The symptoms of impaction are those common to acute obstruction. It has been observed in gall-stone impactions that fecal vomiting comes on early.

The diagnosis of obstruction from enteroliths or gall-stones is always difficult. In the absence of definite signs pointing to other conditions,

[1] Cruveilhier, *Bull. et Mém. Soc. de Chir.*, Paris, 1885, vol. xi. p. 87.
[2] Murchison, *Tr. Path. Soc.*, London, 1869, vol. xx. p. 219.

the existence of a gall-stone should be suspected if the patient is an old woman, especially if a biliary diathesis is evident. Occasionally a stone can be felt through the abdominal parietes. The presence of this lesion, however, can in the majority of cases only be suspected.

Treatment.—The indications for active surgical interference are in no way different from those in acute obstructions from other causes. In the absence of localizing signs a median incision should be made, through which, by digital exploration, the situation of the stone can usually be determined. Extraction should be made through a sufficiently long incision opposite to and parallel with the insertion of the mesentery. The incision should be closed by a continuous or an interrupted Lembert suture in one or two layers. The line of suture is usually so perfect that the abdomen may be closed immediately.

INTESTINAL OBSTRUCTION BY WORMS is rare, but several cases have been reported. Sometimes the masses of worms cause complete and fatal obstruction, as in Halma-Grund's[1] case. Similar cases have been reported by Saurel[2] and Svepp.[3] All these cases occurred in children. A successful operation for the removal of a mass of lumbricoid worms has recently been recorded by Wyeth[4] of New York. Tilton of Lexington in a personal communication reported a case of complete obstruction of some days' duration, in which the gravest symptoms were relieved by the passage of a mass of lumbricoids.

SIMPLE ADHESION WITH FLEXION of the bowel has been a more common cause of acute obstruction within recent years than formerly, because of the great frequency of abdominal operations. Moreover, this lesion is now demonstrated by exploration in many cases that in times past would have been neither diagnosticated nor relieved. Acute obstruction caused by a sharp bend in the intestine at or near an adhesion may occur in appendicitis, in salpingitis, and in other peritoneal inflammations, or as the result of an exploration itself.

The seat of the obstruction is usually in or near the pelvis, and the part involved is the small intestine. A coil becomes firmly adherent by a limited area to some source of inflammation; free movement of the coil is prevented by this abnormal attachment. The passage of the intestinal stream around the sharp bend thus produced is possible until the proximal portion of the coil is unusually distended; even then the lumen remains pervious in the great majority of cases. Occasionally, however, the loaded bowel not only tightens the kink, but presses it firmly against a resisting surface, whereupon complete stenosis takes place and the phenomena of obstruction ensue. Exploration will show a greatly distended coil ending at a sharp angle opposite a firm adhesion, beyond which the bowel will be seen collapsed. Separation of the attachment will release immediately the kink and permit an unimpeded fecal flow. Although the obstruction is practically absolute, in reality no organic narrowing of the lumen takes place. Indeed, after the bowel is freed it is found nearly as distensible as ever, unless the adhesions have been extensive and the external coats changed by inflammatory infiltrations.

The sharp flexion or kink which produces the symptoms in this form

[1] *Schmidt's Jahrbuch*, vol. xcix. p. 92.
[2] *Ibid.*
[3] *Centralblatt f. med. Wissenschaft*, 1888, No. 27.
[4] *New York Polyclin.*, Jan., 1893.

of obstruction may give no trouble for many years; indeed, the lesion may never be suspected until conditions favorable for obstruction arise. The symptoms of obstruction usually appear gradually, the bend at first acting somewhat like a valve, and at intervals permitting the intestinal contents to pass. As the distention increases the closure becomes more and more perfect, until obstruction is absolute.

The **symptoms** in this form of obstruction, therefore, do not appear suddenly. Transitory colic, borborygmus, and local distention are gradually followed by the conspicuous phenomena of complete obstruction. The indefinite tumor of a distended coil may be felt before the distention is general. A history of appendicitis, of pelvic disease, or of any other form of general or of localized peritonitis should suggest the possibility of this form of obstruction.

Treatment.—In this, as in other forms of acute obstruction, interference should be practised as soon as possible, though haste is not as imperative as in those lesions which, unrelieved, are sure to end in gangrene of the bowel.

The seat of the lesion having been exposed as in other forms of obstruction, the adherent coil must be separated with great care to prevent rupturing the intestinal wall at the point of flexion. In recent cases this can be done easily with the finger. In cases of long standing separation can be accomplished only by the use of knife or scissors, for the parts will be found so firmly united that tearing with the nail or with a blunt instrument will be more likely to open the intestine than to divide the cicatricial tissues. When the gut is adherent to parts other than intestine, it is well to dissect the adhesion from the former, leaving the whole cicatricial mass upon the intestine. The danger of rupturing the intestine is by no means inconsiderable, and this accident, occurring at such a time, adds a complication that frequently will prove fatal. Before closing the abdomen the released coil should be left in a free and natural position, where by fresh adhesions it will soon be fixed. If the intestine in spite of great care is torn in making the separation, the opening must be immediately closed; if a considerable portion of the lumen is lacerated, the edges should be refreshed before the suture is made. In some cases the coil will be found so extensively injured that resection and suture will be necessary. At times there will be found at several points adhesions which can be relieved only by prolonged and careful dissection.

The **prognosis** in this form of obstruction, as in that from bands, would be good if operation could be performed in the first twenty-four or forty-eight hours of the attack. If the symptoms are not severe enough to demand early attention on the part of either patient or physician, the prognosis is not seriously affected by delay. If the obstruction can be relieved while the patient's strength is still good, recovery may confidently be expected. Laceration of the bowel in separation of adhesions compromises unfavorably the prognosis.

Six cases of acute obstruction from bands and flexions have occurred in the writers' experience; 3 died and 3 recovered. In the 3 fatal cases the operation was performed as a last resort, the patient's condition being practically hopeless. In the first, an acute obstruction from adhesion of the small intestine to the right horn of the uterus, the adhesions were

separated, but the patient died of shock in a few hours. In a second complete obstruction following an inflammation caused by an abortion, had existed for several days. As in the previous case, there was a sharp flexion of the small intestine near the right horn of the uterus. The bowel was distended above and collapsed below. The distention was so great and the intestinal wall so friable that separation was not accomplished without making several openings into the lumen of the gut. These were closed by interrupted Lembert sutures. The patient died in the course of twenty-four hours. In the third case a similar condition existed from the adhesions formed after an acute appendicitis with abscess. After the evacuation of considerable pus from the pelvis the small intestine was found occluded by a sharp bend at an acute angle. This was easily relieved, but the patient was unable to rally and died in a few hours. In a fourth case, which from the beginning was under daily observation, the symptoms of obstruction were recognized the moment they appeared. A gangrenous appendix had been successfully removed in a very unpromising case. During the convalescence the bowels, which had been moving freely, became constipated and distended. Through the thin abdominal walls peristalsis could be seen gradually increasing in force and in outline. The small intestine was found caught in the pelvis very much in the same way as in the three preceding cases. The afferent coil was much distended, the efferent collapsed. The adhesions, being recent, were easily separated with the fingers, whereupon all the obstructive symptoms subsided. In a fifth case the flexion was caused by a hemorrhagic infiltration of the small intestine in the course of an extra-uterine pregnancy. Separation of the fœtal sac relieved the symptoms, and recovery followed. Recovery followed in a sixth case after the separation of adhesions between the sigmoid flexure and the uterus.

Strangulation by Cords and Bands.—This cause should really include the preceding, for the lesion is very similar; in the one case the adhesions act like a traction diverticulum of the œsophagus, the band being at the outside and pulling away from the mesentery; in the other the band compresses the intestine toward the mesentery. External strangulated hernia excepted, obstruction by cords or bands is the more frequent form: 35 per cent. of all of Leichtenstern's cases of obstruction were of this kind. The primary cause is generally faulty adhesions of some kind occurring in inflammations of the appendix, of the ovaries, and of the tubes. More rarely the obstruction may be caused by a loop in the mesentery or by congenital malformations, as in the case of Meckel's diverticulum. Finally, the bowel may become strangulated in a hole in the omentum.

Bands from peritoneal adhesions, though they may exist anywhere, are usually situated in the pelvis or in the region of the ileo-cæcal valve. Statistics show that this form of obstruction is twice as common in males as in females. The small intestine is affected in over 80 per cent. of all cases. The obstruction consists in an intestinal loop passing under or over the band or in the formation of a flexion or kink, as described above.

Complete stenosis of the intestinal canal from the adhesions following abdominal operations is extremely rare. The cases upon which statistics

rest are in many instances erroneous, because the paresis of general peritonitis is mistaken for that of acute obstruction. Lucas Championnière[1] has reported 6 cases of obstruction from the adhesions following laparotomy, in all of which the first symptoms occurred on the eighth day after operation. Collas[2] of Paris collected 23 similar cases, in 18 of which the operation had been ovariotomy. Of 8 operated on, 4 recovered. In most of the cases the symptoms came on within six days after the operation, but in one they were delayed six years.

The omentum is frequently involved in peritoneal inflammations, especially appendicitis, and at times causes obstructing bands. The intestine may slip through an opening in the omentum and thus become strangulated. Similarly, the mesentery may produre obstruction, the intestine either slipping through an opening or being compressed by a band.

The vermiform appendix may cause acute obstruction by some faulty position by which it acts as a band compressing the intestine. This

FIG. 200.

Strangulation of intestine by the appendix (Warren Museum).

cause of obstruction is extremely rare, only one or two cases having been reported. Graves[3] gives such a case. Another is reported by Nicolaysen.[4] The specimen of a third case is shown in Fig. 200. (For Intussusception and Volvulus see p. 452.)

CHRONIC INTESTINAL OBSTRUCTION.—Chronic intestinal obstruction

[1] *Dublin Journ. Med. Sci.*, Aug. 1, 1893.
[2] *Thèse*, 1891.
[3] *Lancet*, Dec. 6, 1884.
[4] *Brit. Med. Journ.*, July 23, 1892.

may be caused by fecal accumulations without disease of the bowel. In such cases masses collect in the cæcum or in the ascending colon. They are found in the aged, and most frequently in females. Stercoral ulcers and strictures may result, which may lead to the so-called *ileus paralyticus* of the insane.

The usual cause of chronic obstruction is organic disease, either benign or malignant, from which a stenosis results. Acquired benign strictures result from the healing of tubercular, typhoidal, dysenteric, and syphilitic ulcers. They may also result from the spontaneous healing of an intussusception, the bowel contracting at the line of separation between the healthy and the necrotic tissue. Finally, strictures may result remotely from the impaction of foreign bodies, with subsequent ulceration.

Benign tumors within the lumen of the intestine occasionally cause chronic impediment to the passage of fecal matter. The fibrous polyp is rarely large enough to cause obstruction. A few cases of obstruction from cysts have been recorded. Buchwald [1] reports a fatal case of this kind caused by two cysts which were situated outside the bowel and communicated with it. In one case observed and operated upon by the writer a lipoma growing from the internal surface of the cæcum caused intussusception. The tumor was large enough to fill completely the lumen of the intestine, and would have done so but for its situation on the internal surface of the caput cæci, a little to one side of the fecal stream. Once having been caught in the constricting fibres of the intestine, it was forced along, dragging with it the caput cæci, until complete invagination was produced.[2] Reduction of the invagination and removal of the tumor resulted fatally. Tumors growing outside the bowel may cause obstruction by pressure. To this class cysts of the mesentery belong. Obstruction to the small intestine from the pressure of external growths is extremely rare. Obstruction from the pressure of incarcerated pelvic tumors, on the contrary, is not unusual.

Malignant disease is probably the most common cause of chronic intestinal obstruction. The usual form of malignant stricture is a columnar-celled carcinoma. Though sarcoma is uncommon, it does occur in the small intestine. Cases of primary sarcoma are occasionally reported, as in that of Bessel-Hagen [3] in which the jejunum was resected. Jalland [4] reports a case of sarcoma also in the small intestine. Madelung [5] was able to collect 14 cases of this kind, the majority of which were between the ages of thirty and fifty years. The average duration of life in these cases was thirteen months. Sarcomatous strictures are usually primary, starting in the mucous layer. Early metastases to the lymphatics, to the liver, and to the spleen are observed. They are frequently annular, and in the early stages may permit complete excision. In the course of their growth the contiguous structures are infected early. The disease often involves adjacent coils until the whole region is solid with an infiltrating mass. Cancerous strictures usually involve the large intestine. They are situated most commonly at the sigmoid flexure, next in frequency at the ileo-cæcal valve, more

[1] *Deut. med. Woch.*, 1887, No. 40.
[2] *Trans. Amer. Surg. Assoc.*, 1892, p. 205.
[3] *Virchow's Archiv*, vol. xcix, No. 1.
[4] *Lancet*, April 21, 1894.
[5] *Centralblatt f. Chir.*, July 30, 1892.

rarely at the splenic or hepatic flexures. They occur late in life, in men as frequently as in women, either from hereditary disposition and without apparent local cause or from malignant degeneration of cicatrices of ulceration and of pre-existing foci of inflammation. The exciting cause of the disease is unknown and is incapable of demonstration.

Symptoms.—In many cases of malignant stricture no symptoms are observed by which the presence of so serious a disease is even suspected until the first obstructive signs appear. In others constitutional and local signs of cancer may exist long before obstructive symptoms appear. In some cases evidence pointing to organic disease can be elicited only by careful inquiry. The patient may recall occasional attacks of colic. Slight loss of weight and perhaps a trivial malaise may be admitted in some cases; in others no symptoms whatever have been noticed until complete obstruction takes place. Nevertheless, exploration often reveals a stricture so great as to be entirely plugged by the seed of an apple or an orange. On the other hand, the signs of disease are sometimes glaringly plain before the symptoms of obstruction appear: the previous history points clearly to a constitutional cause; the cachexia is marked; the emaciation is great; and a well-defined characteristic tumor is felt. Chronic obstruction from the gradual closure of the intestinal lumen by cancerous growth may, therefore, appear suddenly without previous symptoms, or slowly as the natural sequence of a recognized intestinal growth.

The cardinal symptoms of acute obstruction appearing suddenly in the course of malignant or other strictures do not differ materially from those of acute obstruction from other causes. Obstructions slowly developing in the course of organic disease usually present characteristic signs, even in the absence of definite physical evidence of local disease. Transitory attacks of colic, increased peristalsis, loud gurgling at or near the seat of pain, with the constitutional signs of malignant disease, suggest strongly the possibility of organic stricture. In some cases the bowel above the stricture will be so thickened that, when distended, a rounded, resistant, and tympanitic tumor will be felt. Subsidence of this tumor after the passage of yeasty fæces indicates a letting up of the constriction. Repeated attacks of this kind point conclusively to an organic stricture. In chronic obstruction from any cause, especially if attended by emaciation, violent efforts at peristalsis can be seen through the abdominal walls. Some authorities regard this as a sure sign of chronic obstruction.

Chronic intussusception as a cause of obstruction has been observed. In such cases gangrene of the intussusceptum does not take place, nor is the lumen of the intestine entirely closed.

Symptoms of Acute Obstruction.—Pain, the first and most important symptom of acute obstruction, comes on suddenly in violent paroxysms. Vomiting begins early. At first the vomitus consists of the contents of the stomach only; later, if unrelieved, it contains bile and the regurgitated contents of the small intestine; finally, if the obstruction is in the large intestine, the vomiting may become distinctly fecal. The dark fluid so often vomited in acute obstruction, as well as in general peritonitis, is not necessarily stercoraceous, though often so described. Distention of the abdomen begins soon after the onset of pain and vomit-

ing, and it is at times excessive. Tenderness is usually present—at first local and later general. Obstipation is complete, though flatus and fæces may pass from the bowel below the stricture in the early hours of an acute obstruction, and thus give rise to error. After one or two evacuations of this kind nothing whatever will be passed by rectum. With the onset of the acute symptoms collapse out of all proportion to the severity of the lesion may take place, in some cases making in a few hours surgical interference practically hopeless. In other cases a week even may elapse without grave systemic depression. In those forms of obstruction which are accompanied by extensive sloughing of the bowel and by rapid peritoneal infection early and severe constitutional symptoms may be explained; so, too the slight systemic depression after complete obstruction without necrosis, as in the pressure of a tumor or the constriction by a band. Yet even in the former condition the general symptoms may be slight, and in the latter, contrary to expectation, they may be severe. Hence inferences based upon an excellent general condition are not always reliable. In one case exploration under the most encouraging circumstances will disclose a local lesion practically hopeless; in another operation under most unfavorable and desperate conditions will reveal a trivial cause.

In certain cases physical examination may show a definite tumor. In volvulus, for instance, the affected coil may be felt as an ill-defined resistance through the abdominal walls; in intussusception, as a sausage-shaped tumor; in other cases nothing beyond a general distention can be detected. Though most surgeons justly contend that refinements in diagnosis are unnecessary when acute abdominal symptoms exist which demand immediate interference, yet it is obviously desirable before operation to ascertain as exactly as possible the seat and nature of the lesion present. This, however, must not be done at the expense of valuable time. When symptoms are present which indicate clearly the necessity of exploration, one must be prepared to meet any of the formidable abdominal emergencies.

The greater the violence of the onset, the more acute the pain, the earlier the appearance of vomiting and distention, the more likely it is that the seat of the trouble is in the small intestine. Fecal vomiting is often absent; even when present and persistent it is not pathognomonic of acute obstruction, for it may result from the paresis of a general peritonitis. The temperature is usually normal or subnormal. Local distention is a sign of great diagnostic value, as shown by Obalinski[1] in an analysis of 110 cases. The value of increased peristalsis as a diagnostic sign has recently been emphasized by all writers upon intestinal obstruction. This symptom, however, is not pathognomonic of acute or of chronic obstruction, for it is frequently seen when no obstruction whatever exists. Violent peristalsis is more conspicuous in chronic obstructions than in acute, for in the former the bowel-wall is thickened and strengthened and the abdominal walls are thinned. In many acute forms peristalsis is absent, the intestines being over-distended and paralyzed.

Diagnosis.—For all practical purposes the only diagnosis necessary is that an acute obstruction exists, and that interference is or is not indi-

[1] *Archiv f. klin. Chir.*, vol. xlviii., 1894.

cated. An exact distinction between the different lesions which demand immediate treatment is not only unnecessary, but is often impracticable. Nevertheless, it is essential to make out as clearly as possible the lesion present, that a necessary operation may be hastened, an unnecessary and harmful one avoided. The diagnosis, therefore, between enteritis and peritonitis on the one side and acute mechanical obstruction on the other is of extreme importance. Enteritis in the phlegmonous or ulcerative form occasionally resembles closely acute obstruction. In the former fever is present, with general tenderness. The collapse is not extreme, nor is the obstruction total. No tumor can be felt. Moreover, the history is of great significance, the symptoms appearing slowly and gradually increasing to their full development. Between acute general peritonitis and acute obstruction the diagnosis is sometimes impossible. Acute general peritonitis is always preceded by some exciting cause connected with the abdominal viscera, from which inflammation extends into the general peritoneal cavity. (See Peritonitis.) If such causative lesions are present, differentiation is usually easy; if they are absent, the local and constitutional signs of general peritonitis may simulate so closely obstruction that a correct diagnosis is impossible. Indeed, even when a definite cause for peritonitis is known to exist it may be at times impossible to differentiate between these two conditions.

In the first hours acute obstructions present only the signs of stoppage—pain, distention, vomiting, and obstipation, with perhaps symptoms pointing toward the causative lesion. At this stage acute general peritonitis is accompanied by marked constitutional signs—rise of pulse and temperature. Stasis of intestinal contents takes place later, for paralysis of peristalsis comes on gradually. Auscultation from time to time in mechanical obstruction shows increasing peristaltic action; in peritonitis, diminishing or absent. After the lapse of a few hours some forms of obstruction result necessarily in general peritonitis, in which the symptoms of the original lesion are completely masked. In other forms, general infection not arising, the diagnosis of mechanical obstruction becomes apparent.

Practically, the opportunity for a close distinction between these diseases seldom arises until the signs of both are obscured by an excessive distention. The chief symptoms in the case are at this time almost identical, the minor differences being wholly obscured. The patient, excessively distended, vomits or regurgitates constantly a dark, thin fluid; obstipation is complete; the pulse high; the temperature high or unaffected; systemic depression marked. A case seen at this time presents the greatest obstacles to the formation of a correct opinion. No wonder that the mistake is often made of calling a general peritonitis an acute obstruction; it is by no means confined to the inexperienced.

In some cases the diagnosis can be made by rectal injections or insufflations; in others by a suggestive history; in others by the physical signs of active peristalsis; in others by a slight preponderance of signs toward the one or the other disease; in all, fortunately, it can and should be made without unnecessary delay, by exploration.

In the medical treatment of acute obstructions no cathartic should be used; opium should be given in sufficient quantities to control peristalsis. Active medical treatment consists in rectal injections of gas or

of fluid and in abdominal massage. The former are not to be thought of except in intussusception and volvulus, and even in those diseases they are often not only ineffective, but productive of harm. Massage is applicable especially to impactions from gall-stones, enteroliths, fecal masses, and foreign bodies. It is especially efficacious in conjunction with rectal injections with the patient inverted. The chief objection to the use of massage lies in the danger of hastening an extravasation in those obstructive lesions which compromise the life of the bowel.

The weight of opinion is decidedly against prolonged non-operative methods of treatment. If not successful immediately, they should be abandoned, for the time lost in their employment cannot be spared in most of the lesions which produce acute obstruction.

Operative Treatment of Acute Obstruction.—The operations that may be indicated in acute intestinal obstruction are as follows:

Reduction of an invagination;
Untwisting of a volvulus;
Cutting of a band;
Intestinal resection and end-to-end suture;
Lateral anastomosis;
Formation of an artificial anus;
Enteroplasty;
Enterotomy.

(For the description of these operations see subsequent sections.)

In practically all cases of acute obstruction laparotomy is called for after the failure of palliative measures. Unfortunately, most cases of acute obstruction come to operation so late that no radical measures can possibly be attempted. When the patient's condition is good enough to permit the immediate removal of the exciting cause, that method of procedure should be selected which the seat and nature of the lesion, as determined by exploration, demand. One of the chief immediate dangers in both palliative and in radical operations is the constant regurgitation of liquid from the stomach during anæsthesia, especially when there is great distention. On account of this fact some surgeons deem it important to empty and wash out the stomach before anæsthesia. Though this procedure may be of advantage in those cases in which the strength is sufficient to justify the delay, in urgent cases the doubtful benefit derived makes the loss of time inadvisable. Moreover, as fast as the stomach is emptied it will be refilled by regurgitation from the small intestines, so that the objection to operating when the stomach is distended will not be obviated. This symptom is a grave one, and not infrequently compromises seriously the success of the operation. In some instances, when the patient is fully anæsthetized, a flood of liquid will suddenly be regurgitated from the stomach, filling the pharynx, mouth, and nose, and endangering the patient's life. Even if the surgeon is on the lookout for this symptom, it will sometimes be very difficult, if not impossible, to prevent death upon the table. One anæsthetic seems to be as good as another in these cases, for the vomiting is due to the obstruction. Much more important than the anæsthetic itself is the care used in its administration. Anæsthesia should never be so profound that the patient cannot himself keep his throat clear.

Unless there is some definite reason for a special incision, the median

line should be selected in all forms of obstruction. It may be made above or below the umbilicus according to the preponderance of the symptoms. If very extensive exploration is necessary, the incision may be carried both above and below the navel in order to permit inspection of the whole alimentary canal. The cut through the peritoneum should be small at first, in order to determine the existence of an acute lesion, for in all acute obstruction—and, in fact, in all serious abdominal lesions in which peritoneum is involved—free fluid will escape from the opening. The character of the fluid will indicate in a general way the nature of the lesion. In non-septic cases it will be clear; in septic, turbid or purulent; in hemorrhages, bloody. The escape of fluid of any kind not only justifies the steps thus far taken, but demands further investigation. The situation of the commoner lesions producing symptoms of obstruction should first be explored—in the male the vermiform appendix, in the female the pelvis; next, in both, the sigmoid flexure, the ileo-cæcal valve, the splenic and hepatic flexures of the large intestine, the coils of the large and small intestine, and, finally, the gall-bladder and stomach. In by far the larger number of cases manual exploration performed in this manner will demonstrate the seat, if not the nature, of the lesion. The incision may then be extended to suit the exigencies of the case. If the patient's strength does not justify the prolonged manipulations necessary for the radical cure of the disease or even for its demonstration, an artificial anus may be made by fastening the bowel securely into the wound above the constriction. In this manner the patient may be tided over the existing emergency, and radical operation may be performed later under more favorable circumstances.

Exploration and operation are often much impeded by the excessive distention generally present in acute obstructions. Even if it is possible to demonstrate the lesion, radical operation may not only be seriously embarrassed, but practically prevented, by this condition. Under such circumstances it may be advisable, in spite of the dangers of infection, to incise and collapse one or more coils.

The demonstration of a distended coil and of a collapsed one in the field of exploration is absolutely indicative of an obstruction somewhere between the two. If the collapsed portion is above the ileo-cæcal valve, it shows that the obstruction is in the small intestine. A distended small intestine and a collapsed large one will place the lesion not far from the ileo-cæcal valve. The surgical procedure indicated depends upon the seat and nature of the lesion and the patient's condition.

Manual exploration of the abdomen in cases of intussusception will reveal a sausage-shaped tumor in some portion of the abdominal cavity. The most characteristic sign is the tense band of mesentery drawn into the intussuscepiens with the intussuscepted portion. In volvulus a locally-distended and tense coil will be found. (Vide Intussusception and Volvulus.) The local condition most frequently resembling a volvulus is mesenteric thrombosis, with the changes in the intestinal coil incident to this lesion. The sensations to the fingers are very similar. The affected coil is paralyzed, distended, and resistant, heavy, in color hemorrhagic, dark, and even gangrenous. The necrotic peritoneum is often split by distention, and here and there abraded, the muscular coat show-

ing through. If the necrosis has gone far enough, minute perforations will be found through which contiguous coils will have been infected. Bands can be easily recognized when they are felt.

If the patient's condition is good, the operator may proceed to radical measures. In intussusception gentle efforts should be made to reduce the invagination. Too much force must not be applied for fear of rupturing the presumably necrotic bowel. If reduction cannot be accomplished, resection of the affected coil should be made at the point of constriction. In this manner the necrotic portion of the bowel may be removed and the continuity of the intestine restored either by end-to-end suture or by lateral anastomosis. If this cannot be accomplished, an artificial anus should be made above the point of constriction. In volvulus the incision must be enlarged until the whole coil can be distinctly recognized. The affected portions should then be untwisted. If the integrity of the bowel-wall is impaired or if an extensive thrombosis is present, resection must be performed with end-to-end suture or lateral anastomosis. When the bowel is in a doubtful condition the twist may be reduced, and the coil may be left *in situ* with provisional packing to guard against possible sloughing. Should this occur, an artificial anus will in this manner be formed which can be treated subsequently. (See Intussusception and Volvulus, pp. 452, 459.)

Bands require simply incision for their complete relief. The prolonged pressure of a cord upon the intestinal wall may have resulted in an annular necrosis. This condition I have met with several times in internal strangulation, and very frequently in external strangulated hernia. If the integrity of the bowel at the ring of constriction is doubtful, it is not necessary to resect at this point; the peritoneum above and below may be brought in contact over the ring and sutured there. This is practically an end-to-end suture without resection. The effect of this procedure will be a ring projecting into the lumen of the intestine. This, however, will not interfere with the passage of the fecal stream.

Foreign bodies detected by exploration in the manner described above can be removed by simple linear enterotomy, with subsequent suture.

In most of the lesions causing acute obstruction resection of the gut may be required; hence the question when to do immediate primary suture and when to make an anastomosis becomes an important one. The opinion of the writer is very strongly in favor of immediate end-to-end suture when the patient's strength justifies the time necessary for its performance. Contraindications to end-to-end suture do not depend entirely upon the question of speed, for lateral anastomosis, even with the aid of plates, does not offer any advantages in this respect over the end-to-end methods with similar contrivances. Lateral anastomosis without mechanical aid requires fully as much time as end-to-end suture without mechanical aid. Lateral anastomosis should be performed when for any reason an end-to-end suture cannot be applied; the former procedure has not been satisfactorily shown to be superior to the end-to-end method either in its immediate feasibility or in its remote results. Lateral anastomoses are usually advised when haste is necessary; end-to-end suture, when abundant time is at the operator's disposal.

Surgeons are divided in their opinions, some advocating the formation of an artificial anus with secondary suture, others demanding immediate suture. The mortality in cases of immediate suture is very large. In primary resection and suture of the large intestine Weir, in a collection of 35 cases, found a mortality of 100 per cent. Reichel[1] gives the mortality at 75 per cent. in primary suture and 37 per cent. in secondary resections. (See Intestinal Resection.)

Results of Operation for Acute Obstruction.—The results of operation for acute obstruction will show a very large mortality, though the prognosis is more encouraging from year to year. Before the antiseptic era the gross mortality was 75 per cent.; since then, according to Senn's investigations, it has been about 58 per cent. Curtis[2] collected 328 cases operated on since 1873, with a mortality of 68.9 per cent. In 101 cases the patient was practically moribund when the operation was performed. In 45 of his cases there was excision and suture, with a mortality of 86.6 per cent. In 190 cases in which the operation consisted in relieving the constriction the mortality was 57 per cent.

The above statistics throw undeserved odium upon surgical interference, for the enormous mortality means, in the vast majority of cases, a delayed operation. Many cases are practically hopeless under any method of treatment. They mean an operation performed as a last resort, with the possibility that the patient may not come out of the anæsthetic alive. The results after attempts at relief in these distressing cases make one fact glaringly plain: that the excessive mortality is clearly preventable—that even the most radical measures can be successfully applied in the earliest stages of the obstruction. The etiology and the pathology of acute obstruction show that these lesions in most cases are not incompatible with a favorable prognosis. The excessive mortality is not necessarily the result either of lesion or of operation: delay on the part of the patient, of the physician, or of the surgeon is the responsible cause for the want of success thus far obtained. The future in this most important branch of surgery is promising. It will depend, however, upon a general dissemination of knowledge by which the practitioner may be able to recognize the ominous symptoms of impending calamity in the first hours of the attack. The failure of the patient to call medical aid will of course always result in a large number of practically hopeless cases.

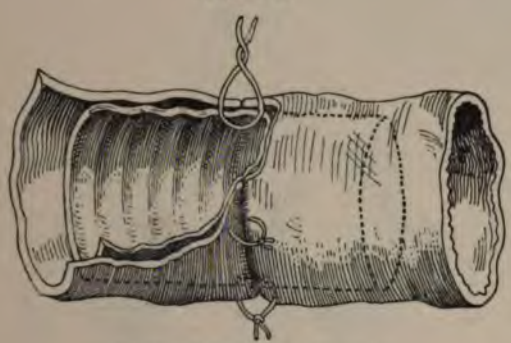
METHODS OF INTESTINAL SUTURE.—The methods of intestinal suture may be described as ancient and as modern. Wounds of the intestine were treated by the ancient surgeons, but without confidence. Intestinal suture is mentioned by Celsus, A. D. 20, and also by Abul Kasem, A. D. 1000. The first definite writings on the subject are the work of Italian surgeons in the Middle Ages. Guilielmus de Saliceto (about 1500) is said to have used a segment of dried intestine, suturing the bowel over it. He and his contemporaries used also the trachea of a goose to keep the lumen of the bowel open, suturing over this with four interrupted sutures. This last method was the suture of the "Four Masters" (Fig. 201). The suture of the "Four Masters," used extensively in the Middle Ages, was, however, so soon forgotten that

[1] *Deut. Zeitschr. f. Chir.*, vol. xix., No. 2.
[2] *Annals of Surgery*, May, 1888.

Du Verger, at the beginning of the last century, used practically the same method and regarded it as original.

The simple glover's stitch was unquestionably one of the earliest sutures used in intestinal wounds. In 1686, Richard Wiseman urged

FIG. 201.



Suture of the "Four Masters."

that wounds of the small intestine ought not to be closed at all, but advised suturing those of the large intestine with the glover's stitch. Heister, in 1739, said that although there was very little use in attempting suture of intestinal wounds, the glover's stitch, if it was done, was the one to be preferred. The prevailing sentiment in regard to intes-

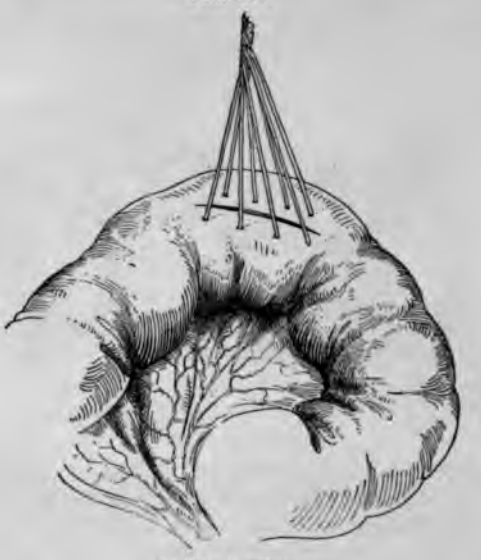
FIG. 202.

Petit's sutura transgressiva.

tinal suture during the last century and into the early years of the present was that wounds of the small intestine ought never to be sutured; wounds of the large intestine might be sutured, but the operation was comparatively hopeless.

After the first of the last century the majority of the method devised to bring the divided ends of the bowel into the abd

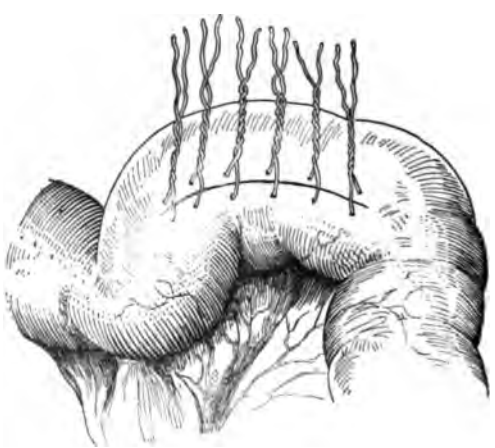
FIG. 203.



Le Dran's suture.

wound and hold them there to prevent fecal extravasation. Sel of Leipsic (in 1720) is said to have been the first one to do thi cessfully in man.

FIG. 204.



Richter's fixation suture.

The methods next to be described will show how the surgeons last century attempted to hold the injured bowel against the ex wound. Palfyn did not suture the wound in the bowel, but pa

single loop around the bowel through the mesentery, thus anchoring the intestinal wound in the external abdominal wound. De la Peyronie modified this method by passing a double thread around the bowel. Others fastened the bowel to the abdominal wall by a single stitch. Bell used a single interrupted suture on each side of the intestinal

FIG. 205.

Löffler's suture.

wound. Kürschner's stitch and the glover's stitch are very much alike, both going through all the coats of the intestine. They were used by the surgeons of the sixteenth and seventeenth centuries, and in the last century were used both to close the intestinal wound and to fasten it in

FIG. 206.

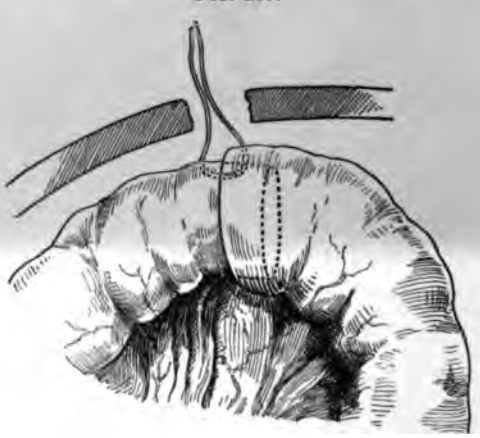
Reybard's method.

the abdominal wound by leaving the ends long. Garengeot's suture was similar to the glover, except that the stitches were placed farther apart. Larrey's double glover suture was simply a double row of glover's stitches. Benjamin Bell modified the glover's stitch by passing

a needle from within out, cutting the threads short at the knots (Fig. 202). The sutura transgressiva, originated by Petit, used also by Sabatier and others, is a simple quilted suture, as will be seen in the accompanying diagram. Le Dran's, Richter's, and Löffler's methods consist in the application of one or more interrupted sutures with long ends, used singly or in a twisted bunch, by which the intestine is brought up to the abdominal wall and fastened there (Figs. 203–205).

Reybard of Paris as late as 1827, acting on the idea that the only value of intestinal suture was to bring the cut surfaces to the abdominal wall and to hold them there, used a thin plate of wood armed with two threads, and applied it as shown in the diagram (Fig. 206). The mortality from such surgery was large, and the cases that recovered had fecal fistulæ; complete uniting of the bowel was therefore attempted. The first successful case of end-to-end suture was that of Ramdohr in 1780, who invaginated the upper end of the divided bowel into the lower, and fastened it with one stitch, joining the bowel to the abdominal wall (Fig. 207). One case of his recovered, but died later from

FIG. 207.



Ramdohr's method of invagination.

some other disease. The healed bowel was removed after death. Louis shortly afterward modified Ramdohr's method by detaching the mesentery from the invaginated portion of the bowel.

Bell invaginated the bowel over a solid cylinder of tallow and sutured with two rows of interrupted stitches. Chopart and Desault used a cylinder of cardboard, fastened with one suture.

All these methods were erroneous, because they approximated mucous to serous surfaces. It was not until the second or third decade of the present century that the proper method of intestinal suture began to be employed.

Travers in his experiments found that sutured intestines in animals, dropped into the abdominal cavity and not fastened to the abdominal wall, held firmly. His careful work, *An Inquiry into the Processes of Nature in Repairing Injuries of the Intestine*, was published in 1812, and was a valuable contribution to the knowledge of intestinal repair.

Modern methods proper began with the work of Lembert, who first taught that it was the union of serous surfaces that was to be aimed at, thus revolutionizing previous thought. Jobert, Faure, and Denans have laid claim to priority, but it must be conceded that Lembert deserves the credit, although the others were his contemporaries and were working toward the same end at about the same time —1824 to 1826. Lembert published his method in 1825[1] and 1826.[2]

FIG. 208.

The Lembert suture.

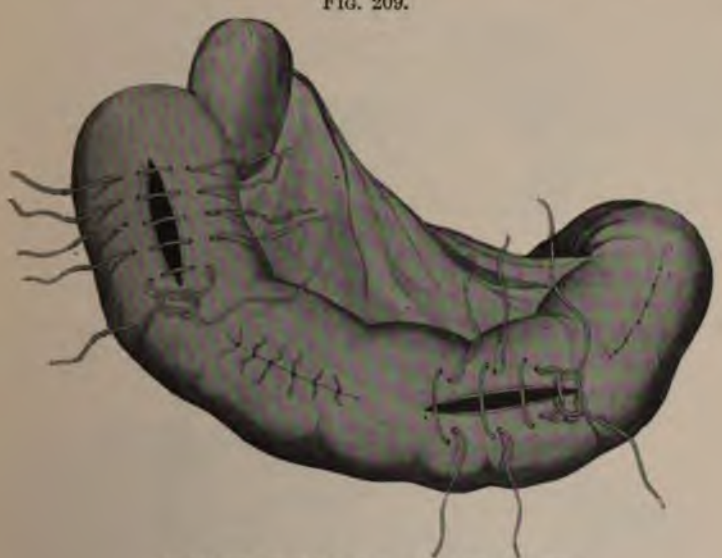
In the discussion of modern methods intestinal suture may be taken up under the following heads:

1. Simple suturing of the bowel, without mechanical aid or invagination, either by interrupted or continuous suture;
2. Union by invagination;
3. Union by mechanical aids.

Interrupted sutures:

1. The interrupted Lembert stitch is to-day the simplest and most used form of suture. The principle to be observed in applying the

FIG. 209.



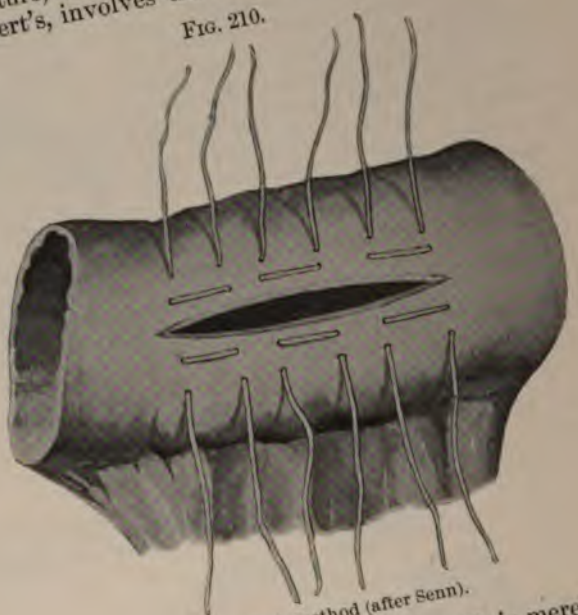
The application of the interrupted Lembert suture.

suture will be seen in the accompanying diagrams (Figs. 208 and 209). It must always be borne in mind that the needle should be passed in and then out on each side of the intestinal wound, without penetrating the mucous membrane. It is evident from the diagram that in this way the serous coats of the bowel are inverted and approximated.

[1] *Bull. de Thér.*, vol. ix. p. 325.
[2] *Rep. gén. d'Anat. et de Phys. et pathol.*, vol. ii, June 3, 1826.

bert's suture, advocated very soon after or almost at the same
h Lembert's, involves the whole thickness of the intestine.

FIG. 210.



Emmert's method (after Senn).

3. Emmert's suture, first described in 1862, is merely a double row of Lembert sutures (Fig. 210).

FIG. 211.

Halsted's plain quilted suture.

4. Halsted's quilt suture[1] is a modification of Emmert's sut
211).

5. The Czerny-Lembert suture[2] is a Lembert suture with

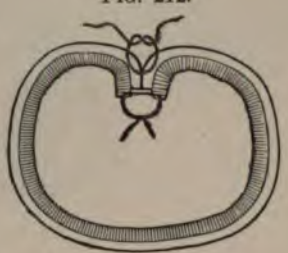
[1] *Internat. Journ. Med. Sci.*, Oct., 1887. [2] *Sammlung klin. Vortrage*, 188

tional row uniting the mucous membrane, the knots of the inner row being turned inward and these stitches ulcerating into the bowel; the Lembert stitches become encysted (Fig. 212).

6. Wölfler's suture is practically the same as the Czerny-Lembert.

Various men, among them prominently Rindfleisch, recently have advocated the use of the Czerny-Lembert suture on the ground that without union of the mucous membrane fecal extravasation may take place between the intestinal coats. It is doubtful whether the advantages of such a method are sufficiently great to compensate for the increased time necessary for its application.

FIG. 212.



Czerny-Lembert suture.

7. Gussenbauer's suture is the application of a running "figure-of-8" stitch, designed to accomplish the same purpose as the Czerny-Lembert.

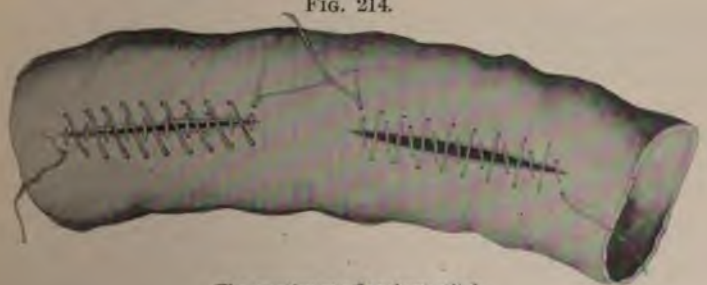
The interrupted sutures that have stood the test of practical use are the Lembert, the Czerny-Lembert, and the Halsted. The Lembert suture is by far the most valuable, because of the rapidity and accuracy with which it can be used.

FIG. 213.

Dupuytren's suture.

Continuous Sutures.—Here, again, the principle of the Lembert stitch has been applied in various ways.

FIG. 214.



The continuous Lembert stitch.

Dupuytren's suture is the simple continuous Lembert stitch. It has the advantage of great rapidity. Other modifications of the continuous Lembert suture are seen in Figs. 213 and 214.

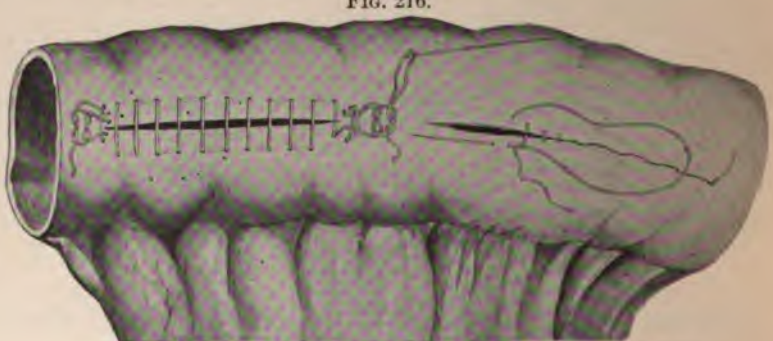
Gely's suture approximates the serous membrane by a cross stitch. A thread armed with a needle at both ends is used, and the stitch is made by changing the needles from side to side.

FIG. 215.

Appolito's suture.

Appolito's suture is a modification of Gely's.[1] One needle is used with double threads, and the suture is applied as a right-angled quilted suture, as shown in the diagram (Fig. 215).

FIG. 216.



Cushing's right-angled continuous suture, in various stages of formation.

Cushing's right-angled suture,[2] a modification of Appolito's, consists in applying the Lembert principle to a right-angled quilted suture (Fig. 216).

Kummer[3] excised a strip of mucous membrane half an inch wide before suturing, thus obtaining an excess of serous coat, which is folded out and united.

Invagination Methods.—Jobert's method is used only in end-to-end resections. It was first described in 1827.[4] The mesentery is dissected away for about one-third of an inch from the cut ends of the bowel. Two sutures, one at the mesenteric border and one opposite, are placed as in Fig. 217, and invagination made. The sutures are then tied. Jobert himself did not knot the sutures, but brought them out of

[1] *Medical News*, 1886, No. 9.
[2] *Boston City Hospital Reports*, 1889.
[3] *Verhandl. der Deutsch. Gesellschaft f. Chir.*, 1891, p. 121.
[4] *Mém. sur les Plaies du Canal intestin*, Paris, 1827.

the abdominal wound and removed them on the fifth day. The folding in of the serous coat is the important principle in this method.

Senn's modification of Jobert's invagination-suture consists of sewing with catgut a thin rubber band about a third of an inch wide into the border of the upper end of the intestine (Fig. 218).

FIG. 217.

Jobert's invagination method.

Maunsell's method[1] is probably the most valuable of the invagination methods. The ends of the divided bowel are fastened with two long sutures, placed opposite each other, as shown in Fig. 219, and by these drawn together out of a slit in the larger segment, so that the peritoneal coats are in apposition (Fig. 220). Sutures are then inserted rapidly, the bowel drawn out, and the temporary cut closed (Fig. 221).

FIG. 218.

Senn's modification of Jobert's invagination method.

Ullmann's modification of this[2] consists in passing and tying four sutures before invaginating through the extra cut in the upper bowel.

MECHANICAL AIDS TO INTESTINAL SUTURE AND ANASTOMOSIS.—Of the various mechanical helps to intestinal suture, the earlier methods will be briefly mentioned for the sake of historical completeness.

[1] *Amer. Journ. Med. Sci.*, March, 1892; *Lancet*, Feb. 13, 1892.
[2] *Centralblatt f. Chir.*, Jan. 12, 1895.

Denans, a surgeon of Marseilles, devised in 1826 a method which is interesting in that it is very similar to the Murphy button of the present time. It consisted of two small rings of zinc or of silver which were inserted into the ends of the divided bowel, and a longer ring of steel with overlapping margins so that it could be made larger or smaller.

FIG. 219.

Maunsell's method.

After the two small rings were in place the larger ring was compressed by a pair of forceps and slipped into the smaller, where it held them

FIG. 220.

Maunsell's method, second stage.

firmly. The inverted serous surfaces became adherent; the rings were released by sloughing.

Baudens modified this method by using a single metal ring with a transverse groove in its centre, and two smaller rubber rings which caught in the groove.

Hendoz used two metal rings with sharp points and perforations corresponding to the points. The points transfixed the mucous membrane and fastened into the other ring.

Amussat in his invagination method used a hollow cylinder of elder with a transverse groove in it.

FIG. 221.

Maunsell's method, third stage.

Neuber used a cylinder of decalcified bone with a deep groove in the centre (Fig. 222). He sutured the ends of the bowel over this cylinder

FIG. 222.

Neuber's method.

with Lembert stitches, first tying a catgut ligature around to hold the divided ends in the groove (Fig. 223).

FIG. 223.

Hollow cylinder of decalcified bone.

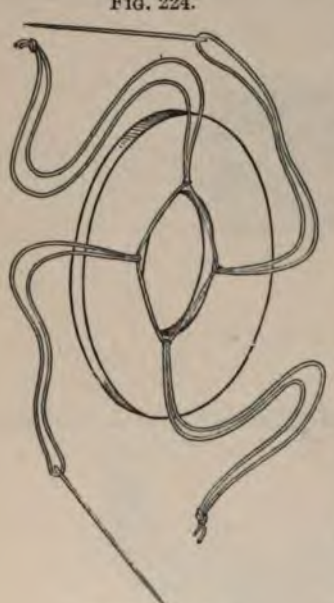
Recent mechanical aids to intestinal suture and anastomosis began with Senn's bone plates in 1887 and 1888. The most important will be found in the following list:

Senn's bone plates;
Dawbarn's potato plates;

Von Baracz's turnip plates;
Littlewood's bone plates;
Robson's bone bobbins;
Sach's bone studs;
Abbe's catgut rings and Matas's catgut mats;
Brokaw's segmented rubber rings;
Robinson's rawhide plates;
Davis's catgut mats;
Stamm's cartilage plates;
Shrively and Simonson's gelatin plates;
Paul's bone tubes;
Ramauge's platinum rings;
Murphy's button.

Senn's Bone Plates.—Lateral intestinal anastomosis, so widely used at the present day, had been worked upon by Maisonneuve, Von Hacker, and Billroth by suture methods, but Senn and Connell of Milwaukee, by their elaborate experiments showed the value of absorbable plates.[1]

FIG. 224.



Senn's bone plate.

The appearance of the plate and the method of threading the needles and securing them to the plate is best seen from Fig. 224. Intestinal anastomosis with these plates can be done very rapidly. The procedure consists simply in cutting a slit first in one portion of the bowel and then in the other, slipping in the plates, transfixing the bowel with the threaded needles, and tying. The use of the plates is shown in Figs. 225–227. In most cases it will be found necessary, for the sake of security, to apply several extra Lembert stitches.

Von Baracz's Turnip Plates.—Von Baracz on the same general plan as Senn fashioned plates from raw turnip, preserved in 1 per cent. solution of carbolic acid.[2] He reports successful cases, and strongly advocates the use of turnips as an available material.[3]

Dawbarn of New York, however, did the first work on vegetable plates, using both potato and turnip as material, but preferring the former. He published his experimental work in 1891,[4] whereas Von Baracz first reported his work in 1892. Rasumowsky[5] has reported very recently a successful case of potato-plate anastomosis after Dawbarn's method, and strongly advocates the use of this material.

Decalcified Bone Contrivances.—Modifications of Senn's plates and

[1] *Trans. International Medical Congress*, 1887, and *Annals of Surgery*, 1887 and 1888.
[2] *Centralblatt f. Chir.*, 1892, p. 575.
[3] *Ibid.*, 1894, vol. xxi. p. 27.
[4] *New York Medical Record*, June 27, 1891.
[5] *Archiv f. Chir.*, 1895, p. 747.

Neuber's hollow cylinders have been brought forward by various men in the last few years.

Mayo Robson[1] uses bone bobbins which differ from Senn's plates in having a central hollow cylinder.

Littlewood[2] uses a very similar modification.

FIG. 225.

Application of Senn's bone plates.

Sachs[3] has used experimentally bone bobbins in the form of shirt-studs.

Bailey,[4] Jessett, Paul,[5] and Horrocks[6] have used straight decalcified bone tubes in the lumen of the bowel in end-to-end resection. Paul's tube has been used 4 times up to 1895, with 3 recoveries and 1 death.

A variety of other substances have been used for plates and rings.

Abbe's catgut rings were rings made of large-sized catgut wound over four or five strands or coils of the same.

[1] *British Medical Journ.*, 1893.
[2] *Lancet*, April 16, 1892.
[3] *Centralblatt f. Chir.*, Oct. 4, 1890.
[4] *British Medical Journ.*, July 14, 1894.
[5] *Ibid.*, 1894, vol. i. p. 235.
[6] *Ibid.*

Davis, Matas, and Brokaw adopted the same idea, with slight modifications.

Brokaw's rings were made of catgut coils covered with segments of rubber tubing.

Robinson[1] of Toledo devised plates of rawhide to be used in the same manner as Senn's bone plates, and also used a segmented plate of hard rubber laid over a ring of rawhide. Robinson also used experimentally cartilage plates. He found that they absorbed too quickly.

Shrively and Simonson use chromicized gelatin plates.

FIG. 226.

Completed anastomosis by Senn's plates.

FIG. 227.

Intestine, cancerous stricture: operation for relief. Senn's bone plates (Warren Museum).

Murphy Button.—This valuable appliance was first described in 1892.[2] It suggests the old rings of Denan. The appearance of the button and the principles of its use are shown by Figs. 228–234. It can be used successfully both in intestinal resection and anastomosis, and with the smallest consumption of time.

Ramauge of South America, in a paper read at the International

[1] *Medical News*, Mar. 14, 1891.

[2] *Medical Record*, Dec. 10, 1892.

Medical Congress of South America, Jan. 20, 1893, presented an aluminum button somewhat similar to Murphy's, but without the spring.

Fig. 228.

Operations on the Intestine.—*Intestinal Resection.*—Resection of the intestine is indicated—

(1) Whenever the integrity of the bowel is seriously compromised—

(*a*) By internal or external strangulation;

(*b*) By mesenteric embolism or thrombosis;

(*c*) By injuries.

(2) For the radical restoration of the lumen in cases of benign stricture; for the extirpation of tumors and malignant strictures, with restoration of the continuity; for intussusception; and for the cure of fecal fistulæ.

Methods of applying purse-string suture in using the Murphy button.

Most of the lesions requiring resection involve the small intestine. In intussusception, volvulus, and at times strangulated hernia, especially of the umbilical variety, the large intestine is usually the seat of the disease requiring operation. Cases of intestinal resection for external

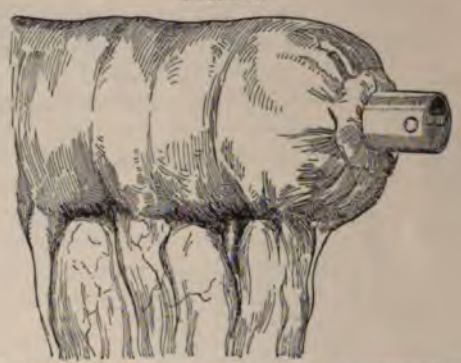
Fig. 229.

Murphy button.

strangulations with gangrene are found in the earliest records of surgery. Ramdhor, Arnaud, and Reybard are credited with successful operations between 1727 and 1843. In recent years this operation has been used for the radical relief of an increasing variety of intestinal

lesions, until at the present time the field is a wide one and its successes are among the most brilliant in surgical records. Reichel was able in 1883 to collect 121 cases. Billroth himself up to 1890 had performed

FIG. 230.



Button held by purse-string suture, ready for approximation.

145 resections, including those of the stomach and of the intestines. Rosenthal[1] tabulates 151 cases of resection performed since 1880:

Hernia, 42 cases; mortality 40.5 per cent.
Artificial anus, 44 cases; mortality 43.2 per cent.
Neoplasms, 23 cases; mortality 46.5 per cent.
Obstruction, 21 cases; mortality 48 per cent.
Wounds, 16 cases; mortality 37.5 per cent.

FIG. 231.

Second portion of button ready for approximation.

It is especially desirable in resection of the intestine to have the bowel empty, not only because the manipulations are much easier, but because the danger of fecal escape and peritoneal infection is thus reduced to a minimum. Distention seriously impedes most operations upon the intestine, and often compromises success. In acute emergencies and in chronic

[1] *Wien. med. Woch.*, 1892, No. 12.

obstructions the bowel cannot be emptied until it has been incised

FIG. 232.

Parts of button approximated in end-to-end union.

Preliminary washing out of the stomach may be employed, but it is of doubtful efficacy. After as careful preparation of the field as time

FIG. 233.

End-to-end approximation, button in position.

allows, a cut should be made sufficiently long to permit free delivery of the affected coil. If this is brought out of the wound, the danger

FIG. 234.

End-to-end suture by means of Murphy button between a coil of large lumen and one of small.

from sepsis is very much lessened. Before cutting into the bowel gauze barriers should be placed with the greatest care about the coil. If the

distention is great, the coil should be emptied into a basin through a small cut with as little spilling as possible. The gauze immediately about the cut should be renewed as soon as the fæces have stopped flowing. The bowel above and below the portion to be removed should now be compressed by the fingers of an assistant or by means of me-

FIG. 235.

Line of section used in a case of tubercular stricture of the cæcum. The small intestine is much distended and thickened, the ascending colon collapsed.

chanical aids—ligature, clamp, etc. If the clamp is used, great care must be taken not to injure the bowel. The preference of most surgeons is for digital compression. By means of scissors the collapsed coil is now rapidly cut transversely above and below the disease as shown in Fig. 235. Its mesentery may be ligated in sections or a

FIG. 236.

Coils compressed by fingers of assistant. First three sutures in position.

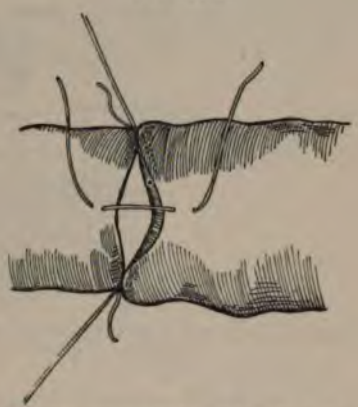
V-shaped piece may be removed, according to circumstances. Slight fecal escape, possible in spite of compression, may be absorbed by small pieces of gauze placed in the lumen of the intestine above and below the cut. This procedure is of doubtful efficacy, however, for the suture

begins immediately, and the gauze may be forgotten, as in one case of my own which required removal of the stitches and resuture. The first stitch may be applied opposite the mesenteric attachment; the second and third, on either side of the mesentery (Figs. 236–238). The coaptation at the mesenteric border must be made with the greatest care, in

FIG. 237.

First and second sutures in position.

FIG. 238.



First two sutures tied, third ready to tie.

order that the joint may be perfectly tight, for it is here that extravasation from giving way of the sutures is most likely to occur. In some instances the mesentery is heavily loaded with fat, and its insertion into the bowel therefore broad. In such cases the mesentery must be stripped back a short distance to allow the application of sutures directly

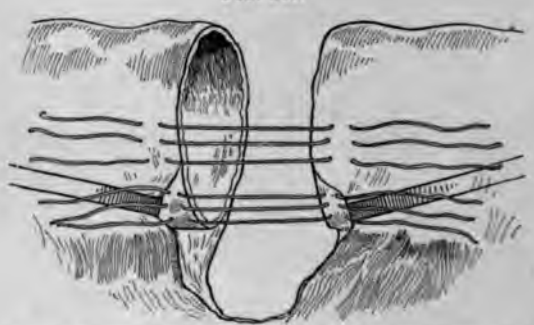
FIG. 239.

Method of applying sutures at the mesenteric border and in the mesentery itself.

to the fibrous wall (Fig. 240). The peritoneal surfaces of the mesentery can then be united by an additional line of suture (Fig. 239). The circle is completed by interrupted suturing in both directions. The order in which stitches are applied is of no importance, however, after the mesenteric border has been made secure (Figs. 239-243). The above technique must be varied if other than interrupted sutures are

preferred. The kind of suture used depends upon individual choice. The preference of most surgeons is strongly in favor of the interrupted Lembert. A second row may be applied if time permits, though this is not essential to success. Moreover, a ring is thus caused to project into the intestine which may result in a secondary and fatal obstruction.

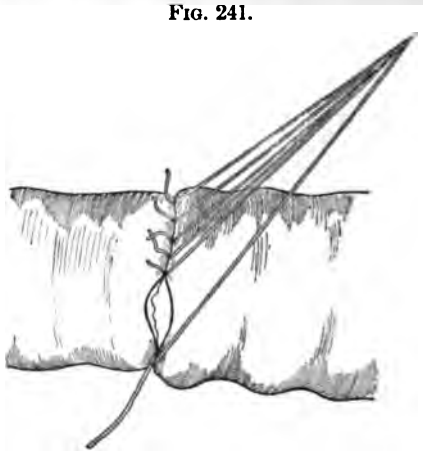
FIG. 240.



Mesentery loaded with fat stripped back and held by means of retractors to permit insertion of sutures into the fibrous coat.

It is doubtful whether lateral anastomosis after resection offers any advantages over end-to-end suture, even in speed: more sutures are necessary, approximation is quite as difficult, and extravasation fully as frequent. Moreover, the natural course of peristalsis is interfered with, and the opening always contracts. Under circumstances of extreme

FIG. 241.



Ends of sutures left long to facilitate rotation, to keep bowel steady, and to aid in the application of sutures.

gravity the cut ends may be quickly fastened into the abdominal wound. If recovery follows, restoration of the canal may be made later. After the completion of the suture some provision should be made for the possible giving way of a stitch and consequent extravasation. This accident is the principal cause of death after resections. A small

strand placed at the line of suture and emerging from the wound will provide an outlet for possible extravasation. The external wound may

FIG. 242.

Union of a distended with a collapsed coil. As the fecal stream distends the distal coil the sutures become farther apart and require the application of additional ones.

FIG. 243.

Suture completed after distention of distal coil.

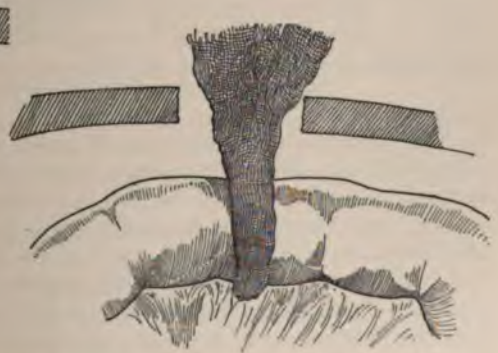
then be almost entirely closed. The gauze may be removed at the end of forty-eight hours (Figs. 244 and 245).

Lateral Anastomosis.—Lateral intestinal anastomosis consists in the formation of a communication between portions of the alimentary tract

FIG. 244.

Provisional gauze drainage. View in section.

FIG. 245.



Method of provisional gauze drainage.

more or less remote from each other. Through this artificial opening the intestinal stream is diverted from its normal course and a short cut

is established by which some obstacle to the flow is avoided. The principle of anastomosis applies to those obstructive gastric and intestinal lesions which do not permit extirpation with restoration of the canal. In this field its usefulness and excellence are unquestionable. In hopeless cases of malignant obstruction the method obviates the necessity of artificial anus with its distressing features. In some instances of obstruction it offers the only possible radical relief. Lateral anastomosis is indicated whenever the causative lesion is too extensive for excision, when end-to-end suture is impossible, and, according to some authorities, as a substitute for end-to-end suture (Figs. 246 and 247).

FIG. 246.

Resection with lateral anastomosis. The ends of the bowel are inverted and closed; the lateral cuts are sutured posteriorly.

The principle of lateral anastomosis, first suggested by Billroth and performed by means of suture alone, was taken up by others, who applied mechanical aids to the perfecting of the technique. Chief among these mechanical devices are the decalcified bone plates of Senn. Modifications of Senn's idea were made by Abbe with rings of catgut, and by Brokaw with rubber tubing strung on catgut. Later, Murphy with his ingenious button has made the operation of lateral anastomosis with mechanical aids as nearly perfect as it can be, yet many surgeons do not admit that mechanical aids are essential to the best performance of this operation. The chief objections to the use of such devices are the insufficient size of the opening, the probability of contraction, and the danger of the device itself becoming impacted, especially if non-

absorbable materials, such as the Murphy button, are used. Abbe and Brokaw have both abandoned the use of these devices in the performance of lateral anastomosis. The artificial opening between the intestinal coils must be very large to prevent subsequent contraction from cica-

FIG. 247.

Anastomosis completed with continuous Lembert suture.

trization. Lateral anastomosis by the Murphy button can be performed with great rapidity, and technically this operation is perfect. Unfortunately, in the hands of many surgeons fecal extravasation has taken place through the tissues compressed by the button. Moreover, in some instances the button itself has caused subsequent trouble.

Intestinal anastomosis is usually made between coils above and below the lesion without resection of the disease itself. The principle may, however, be applied after resection of the gut as a substitute for end-to-end suture. The open ends of the intestine are inverted and closed and a lateral communication then made between the proximal and the distal coils. As soon as the nature and the extent of the lesion have been fully determined the coils above and below the disease are brought out of the wound and held in easy approximation. A longitudinal cut, of at least three inches, is then made in each opposing coil opposite the attachment of its mesentery. The posterior line of incision is sewed together by continuous stitch, which is then carried about the whole incision. The needle is passed through all the intestinal layers. At the completion of this preliminary step the contiguous coils will be in close

approximation, with a large opening between them. This line of suture, however, is not sufficient, for extravasation may take place between the stitches. A second row, entirely peritoneal, should now be carefully placed so as to include the peritoneal surfaces approximated by the first stitch. Mechanical aids—buttons, rings, plates, etc.—introduced into the openings of the contiguous cells may be used for rapidity. In the use of the Senn's plates, for instance, the operation consists merely in the insertion of the plates, the transfixion of the intestine by the needle, and the tying of the knots. (See p. 324.) In the use of the Murphy button a preliminary purse-string stitch is taken about the line of the proposed incision, within the limits of which the two portions of the button are slipped. The purse-string is then tightened, the buttons pressed together, and the operation is completed. The rings of Abbe and Brokaw are used in the same manner as the plates of Senn. By all these methods the chief danger is extravasation between the stitches. Most surgeons, therefore, for greater security, prefer an additional line of sutures. When excision of the disease is performed the open ends of the bowel are first closed by inversion and suture. The lateral anastomosis is then performed as described above.

Invagination.—Invagination offers a rapid and safe method of restoring the intestinal lumen. The principle was recognized among the earlier methods of circular suture, but the peritoneum was brought in contact with the mucous surface. The principle of invagination is applied by drawing the distal into the proximal bowel, reversing the natural order of invagination seen in disease. If the proximal is invaginated into the distal portion of the bowel, artificial intussusception may be produced. Several methods of invagination have been devised—Jobert's, Senn's modification of Jobert's, Maunsell's, and Ullmann's modification of Maunsell's. (See p. 321.) Stitches are passed through the divided ends of the bowel and the threads are cut and left long. These threads are then passed into the proximal intestine and drawn out through a small longitudinal incision. The two ends thus brought out of the intestine lie together with their mucous surfaces outside and their peritoneal inside, the peritoneal surfaces being therefore in close approximation. The sutures are then rapidly applied. Traction on the invaginated portion draws the inverted bowel back through the longitudinal cut. The suture will then be found to be complete and very perfect. The longitudinal cut is then closed in the usual manner. This method, when once understood and practised, can be performed rapidly and is very effectual.

Choice of Methods.—The method to be used in restoring the intestinal canal after resection depends somewhat upon the nature and extent of the lesion. When it is possible to bring the ends easily together and make a good joint, upon which little if any traction is likely to be brought, the end-to-end suture is greatly superior to any other method, because the peristalsis will follow its natural course, and because there is little if any danger of stricture at the line of suture. If speed is essential in a given case, the Murphy button may be used. When the cut ends cannot be brought easily into approximation, they should be closed and the coil above and below united by lateral anastomosis. This method, however, should not be used if end-to-end suture can be satisfactorily applied.

The length of intestine that can be removed with recovery has been a question of great clinical and experimental interest. A number of successful cases have been reported in which more than a metre has been excised, either with the formation of an artificial anus or by circular enterorrhaphy. Senn, after numerous experiments on animals, concluded that in dogs the excision of more than one-third of the small intestine is dangerous to life and results in marasmus. Trzebicky's[1] experiments on dogs show that the recovery depends not always so much on the amount of intestine removed as upon its situation. After resecting portions varying in length from twenty-five to two hundred centimetres from the jejunum, from the middle of the small intestine, and from the ileum, he found that in all the cases that recovered there was a loss of weight for a few days—the greatest and the longest in excision of the first part of the jejunum. No case died of inanition until one hundred and fifty centimetres had been taken, including the first part of the jejunum. Two hundred centimetres from the first and last parts of the intestine caused death. In the majority of cases the loss of weight depended upon the length of intestine resected. He found that in animals half the small intestine could be resected if the duodenum was left intact. When more than two-thirds of the small intestine is removed the animal can digest nothing, has uncontrollable vomiting and diarrhœa, and emaciates rapidly. In man probably one-half the minimum length of the small intestine—that is, two hundred and eighty centimetres—is all that can possibly be removed; moreover, to have any chance of recovery, the patient must be free from all exhausting complications. Several cases have been reported in which more than a metre of small intestine has been successfully removed: Billroth,[2] Bruns,[3] Kocher,[4] Hahn,[5] Schlange,[6] Baum, all referred to by Trzebecky.[7] Elliot[8] of Boston has removed successfully 109 cm.

Intestinal Resection for Mesenteric Embolism and Thrombosis.—Necrosis of the intestine dependent upon disease of the mesenteric vessels must be borne in mind in the consideration of all acute abdominal conditions. Patients occasionally present symptoms of acute obstruction from this cause. The lesion cannot be diagnosticated with certainty until exploration is made.

The **symptoms**, coming on suddenly, are those of acute obstruction; there are distention, obstipation, vomiting, and shock. If the disease is confined to one or two coils, a tumor can sometimes be felt through the abdominal wall. On exploration the affected coils will appear distended, dark in color, heavy, and sometimes necrotic. Without surgical interference the lesion is necessarily fatal. In such cases the affected coil should be removed, the cut being made well above and below the diseased portion. The patient's condition is usually so serious in this lesion that there is no time for a satisfactory suture. The ends of the bowel must therefore be brought to the wound, and a suture can be performed later, as in Elliot's case.[9]

[1] *Archiv f. klin. Chir.*, vol. xlviii. p. 54.
[2] *Verhandl. des 12ten Congresses der Deutschen Gesellschaft f. Chir.*
[3] *Beitrage zur klin. Chir.*, vol. ii. p. 495.
[4] *Corresp.-Blatt f. Schweizer Aertze*, 1886, No. 5.
[5] *Berlin. klin. Woch.*, 1887, No. 25.
[6] *Ibid.*, 1892, No. 47.
[7] *Archiv f. klin. Chir.*, vol. xlviii. p. 54.
[8] *Annals of Surgery*, Jan., 1895.
[9] *Ibid.*, Jan., 1895.

The prognosis in mesenteric embolism and thrombosis is necessarily grave, not only from the local lesion, but from the remote cause, the plugging of the artery or vein resulting sometimes from fatal diseases of other viscera. If the larger trunks are affected, the circulation may be cut off from so much of the intestinal tract as to preclude the possibility of repair. Elliot's brilliant success encourages the hope that a certain number of these cases may be successfully treated by immediate resection. The recognition of this lesion before exploration is extremely difficult, if not impossible. In all cases attended by acute pain, distention, vomiting, etc. one must be prepared to meet with this condition, especially if the patient's general health has been impaired previously, if he is advanced in years, or if he has presumably an enfeebled circulation and diseased arteries. Acute abdominal symptoms suggesting embolism or thrombosis develop occasionally in the course of severe injuries, especially in fractures of the thigh. Occasionally the circulation is affected by fat-embolism and fat-necrosis. Whatever the pathological cause may be, the outlook is grave.

Enterotomy is a term usually restricted to openings made in the small intestine. Enterotomy was first suggested by Mannoury in 1819, but was first performed by Nélaton in 1840, and it has therefore been called Nélaton's operation. Opening the intestine for the relief of obstruction is an emergency operation usually performed for the purpose of tiding the patient over the symptoms of acute obstruction. It is not resorted to if the patient's strength justifies radical relief of the lesion. Obstructions from any cause, necrosis of the bowel or strictures which cannot be treated radically, are the usual conditions for which temporary relief is desirable. The operation consists merely in incising the bowel and suturing it to the abdominal wound. The objection to the operation is that nutrition is interfered with, especially if the bowel is opened high up. Even if the incision is so situated that nutrition is sure sooner or later to be impaired, the operation may be successful in carrying the patient through the immediate dangers of his condition, and thus permitting secondary restoration of the canal before his strength is seriously compromised. Curtis[1] in an analysis of 62 cases in which this operation was performed for obstruction found that 46 were relieved by the operation, and 6 were not relieved; 32 recovered and 30 died. Passage of the fæces *per anum* was resumed in 60 per cent. of the recoveries.

If the obstruction is not organic and does not demand resection, in the course of time the fistula closes of itself.

Jejunostomy has been performed occasionally as a substitute for gastrostomy. Albert[2] reports a case of sarcoma of the pylorus and neighboring structures so extensive that neither resection nor anastomosis could be performed. Under such conditions the jejunum may be opened. The jejunum should be opened rather than the duodenum, because of the difficulty of operating upon the latter. Care must be taken in this operation not to interfere with the excretion of the bile and pancreatic fluid. Jejunostomy has been performed by Albert (2 cases) and Hahn[3] (5 cases). The upper part of the small intestine can easily be found through a median incision just above the umbilicus. There is little difficulty in

[1] *Medical Record*, New York, 1888.
[2] *Wien. med. Woch.*, 1894, No. 2.
[3] *Deut. med. Woch.*, 1894.

recognizing the jejunum, though in lumbar colotomy it has been mistaken for the descending colon. In such cases the patient usually dies from inanition.

Enteroplasty is a term applied to operations upon the intestines by which fibrous strictures are remedied without resection. A longitudinal cut is made through the constricted portion of the gut. This by means of sutures is made into a transverse line, precisely as in pyloroplasty. Allingham[1] reports 2 successful cases in which this operation was performed. His are the first, if not the only, recorded cases.

Adhesions.—It is very desirable to prevent, if possible, the formation of adhesions at the time of the operation, on account of the frequency and severity of the symptoms which they cause. Aseptic abdominal operations for lesions in which there is no peritonitis are seldom followed by adhesions. Even extensive localized inflammations, especially those caused by appendicitis, recover frequently with few if any adhesions. On the other hand, the peritoneal surfaces may become agglutinated so firmly as to cause even complete obstruction, without manifesting at the time any symptoms of peritonitis. The adhesions that do occur after laparotomies have been ascribed to sepsis, to the drying of the peritoneum from exposure, to the use of antiseptics, etc. Walthard,[2] as the result of experiments, concludes that long-continued exposure to the atmosphere predisposes to adhesions, from the drying of the superficial cells of the serous coat. After experimental work on dogs, cats, and guinea-pigs, in which the operations were performed under varying conditions, Thompson[3] concluded that adhesions cannot be prevented either by antiseptic or aseptic solutions, or by an aseptic atmosphere at the time of operation, and that sterile foreign substances, such as silk and gauze, become encapsulated and practically harmless.

The theories advanced to explain the formation of adhesions have led to various modifications of technique, among which are extreme care in preventing sepsis, the avoidance of antiseptic solutions, and the use of mechanical substances. Senn advises omental grafts for this purpose. Morris[4] suggests an aristol film; Baum,[5] thin plates of absorbable tissue (catgut) or fresh animal peritoneum sterilized. The use of any of these methods is of extremely doubtful efficacy.

Adhesions between abdominal viscera are doubtless frequently the cause of obscure pain. In such cases adhesions may be found gluing the intestines to each other or the stomach to the intestines; there may be adhesions of the gall-bladder, the liver, or the abdominal wall. The frequent presence of adhesions in cases of obscure abdominal pain, in which no other lesion can be found, seems satisfactorily to explain the symptoms when, after separation, the patient recovers.

Very little can be found in the literature of this subject until very recently, though most operators have probably seen cases of this kind. Adhesions are especially common between the gall-bladder and the large intestine. Several such cases have occurred at the Massachusetts General Hospital, in which recovery has followed an exploration with separation of adhesions. At the Sixteenth Surgical Congress (German)

[1] *Lancet*, June 23, 1894. [2] *Correspondenzblatt für Schweizer Aertze*, 1893, No. 15.
[3] *Centralblatt für Gynäkologie*, Jan. 31, 1891.
[4] *Amer. Journ. Gynæcol.*, Oct., 1891. [5] *Amer. Journ. Med. Sci.*, Aug. 11, 1894.

Credé contributed 3 cases of this kind. A similar case is reported by Maydl.[1] Lauenstein reports 10 cases of long-continued pain connected with the gastro-intestinal tract in which adhesions between different abdominal viscera were found. Long-continued and disabling pain, definitely located, though at times doubtless of nervous origin, suggests the possibility of adhesions between viscera and justifies sooner or later an exploration.

PERITONITIS.—Inflammation of the peritoneum is now regarded as always septic in its origin. Idiopathic peritonitis—peritonitis caused neither by the presence of germs nor associated with them—probably does not exist. Micro-organisms from some source or other gain access to the peritoneal cavity. The infection may be direct from contiguity with a septic focus, or indirect as the result of a chemical or a toxine. In the former case the germ makes its way directly into the peritoneal cavity; in the latter, toxines or chemical products generated more or less remotely affect the peritoneum through the circulation. In most forms of peritonitis the source of the infection is obvious; in others it cannot be made out. In some instances the micro-organisms can be easily cultivated and isolated; in other cases the cultures are sterile. In all forms the gross lesions of inflammation are evident. Failure to detect micro-organisms in certain unmistakable peritoneal inflammations is due undoubtedly to some germ which does not grow in the ordinary culture-media.

The commonest form of peritonitis is that caused by infection from some portion of the alimentary canal. This may occur in the course of those diseases which by necrosis may perforate the intestinal wall, such, for instance, as inflammations of the vermiform appendix, acute obstructions, intussusceptions, strangulations, and the various forms of ulcer. The common micro-organism present in peritonitis resulting from all these causes is the bacillus coli communis. Infections caused by the rupture of abscesses, by imperfect asepsis during surgical operations, and by extension from the genital tract, etc. are associated with the common forms of pus-cocci. More rarely acute peritonitis occurs in the course of acute and chronic diseases themselves dependent upon a germ. Among such forms is that in which the pneumococcus is found. Other indefinite peritoneal infections may be due to such uncertain irritants as syphilis, rheumatism, and gonorrhœa, in many of which the presence of a germ has not been demonstrated. In this class belongs the peritonitis sometimes seen in the new-born, though in some instances the invasion takes place through an infected navel. Finally, peritonitis may be of tubercular origin. (See Tubercular Peritonitis.)

The great extent of the peritoneum, with its enormous powers of absorption, accounts for the rapid, profound, and usually fatal systemic toxæmia seen when a considerable portion of the membrane is affected. The fact that peritonitis is generally fatal from septic absorption was recognized by Wagner[2] in 1876, before the germ theory had been fully developed. The absorption of ptomaïnes is sometimes so rapid that death takes place before the usual signs of suppuration are evident. In a large proportion of cases at autopsy no distinct pus-formation is found. In some the change in the peritoneum is hardly noticable, even though the

[1] *Wien. med. Zeitung*, 1889, Nos. 8 and 9. [2] *Archiv für klin. Chir.*, 1876.

presence of an acute general infection is unmistakable. In other cases the whole peritoneal cavity is found flooded with pus. The intensity of the inflammation, the rapidity of its course, and the depth of the systemic depression may be entirely out of proportion to the local signs. In one case a micro-organism of little toxæmic power will be found, in another, one of great activity and intense virulence. In 57 deaths from peritonitis at the London Hospital the exudate was purulent in only 15; in 31 there was no sign of pus.

Different portions of the peritoneum seem to present different degrees of vulnerability to sepsis. The most sensitive region is that over the small intestine; the parietal peritoneum is much less susceptible to infection. Local peritonitis is generally found over the liver, in the pelvis, or about the vermiform appendix.

Of all the forms of peritonitis, the most virulent is generally that in which the contamination starts from the intestine. Yet certain infections from other sources pursue quite as fulminating a course. Such, for example, are those from faulty asepsis in which a virulent germ is introduced by instruments or by the fingers. It has been noted, also, that the contents of the uterus at times possess an extreme virulence. A fulminating peritonitis may be produced by certain forms of salpingitis, by certain inflammations of the liver or gall-bladder, and by the rupture of abscesses in various localities. In these forms the micro-organism is generally the streptococcus. In rare instances some of the milder pus-cocci seem to have an unusual virulence. As a rule, however, peritonitis caused by infection from the intestine is the most rapid in its progress and the most fatal in its results.

The bacillus coli communis, first described by Escherich[1] in 1885, is the chief microbe found in a septic infection starting from the intestine. Its definite pathogenic qualities were not recognized until 1889. They have been described by Roux,[2] Rodet, Laruelle,[3] Park,[4] Mascaigne,[5] and Welch.[6]

Notwithstanding the fact that Sternberg gives a list of 48 micro-organisms which have been found in the human intestine, cultures taken from cases of intestinal extravasation generally result in pure colonies of the colon bacillus. This is probably due to its great powers of rapid reproduction, through which other less active organisms are crowded out of existence. On the other hand, it has been stated, as a result of experimental work, that the influence of the colon bacillus has been very much exaggerated; that pure cultures of the micro-organism have been disseminated throughout the peritoneal cavity of animals without bad effect; and that the chief factor of the infection is a more virulent though less conspicuous germ. Whether the growth of the colon bacillus is an effect rather than a cause cannot be demonstrated. Its constant presence in all cases of peritonitis of intestinal origin justifies the opinion that it has a great influence as a causative factor.

The colon bacillus has been thought to form 95 per cent. of the organisms met with in the human bowel. In many ways it resembles

[1] *Fortschritte der Med.*, 1885. [2] *Lyons méd.*, 1889. [3] *La Cellule*, 1889, vol. v.
[4] *Trans. American Surgical Association*, 1893.
[5] *Le Bact. Coli Commune, son Rôle dans la Pathologie*, Paris, 1892.
[6] *Trans. Congress Amer. Phys. and Surgs.*, vol. ii.

the typhoid bacillus, and its distinguishing features have been fully described by Trambusti, Pere, and Wurtz.[1]

Twenty varieties of this bacillus have been described, all more or less virulent. Zeigler and Arndt have shown experimentally that the colon bacillus shows no tendency to penetrate the healthy intestinal wall, but when the intestinal wall is diseased the microbe penetrates it, and is found in great numbers in the surrounding tissues. Cultures, even from remote organs, after death frequently show the presence of this bacillus. In internal strangulations, in strangulated hernias, in twists, in mesenteric embolism and thrombosis, this micro-organism is found very early in the surrounding tissues. Boennecken[2] in 13 out of 15 cases of hernia found this bacillus in the sac. Mascaigne gives 35 cases of peritonitis in which the colon bacillus was the only organism. Barbacci[3] states that it is the only micro-organism found in perforative peritonitis in man. In an analysis of 23 cases of intestinal perforation and peritonitis Tavel and Lanz[4] found no organism in 3, but in 19 found the colon bacillus either alone or with other organisms. Darling[5] reports the almost constant presence of this organism in cases of appendicitis. Park, Bignami, Bastienelli, Le Sage, and Mascaigne have shown the presence of the colon bacillus in inflammations of the biliary passages. It has also been found after laparotomies in which every aseptic detail has been carried out. This fact has been noted particularly by Welch. In such instances the bowel-wall has probably been so injured as to permit the passage of the bacillus through it. The colon bacillus has also been found in the lungs and in the pleuræ in cases of pneumonia following peritonitis. From all the evidence thus far obtained the colon bacillus must be regarded as of the utmost importance in the etiology of peritoneal infections. Its influence in the production of peritonitis is conspicuous in all lesions of the intestine in which the circulatory activity of the bowel is impaired.

Infections not dependent upon extravasation from the alimentary canal are due to the various forms of pus-organism, the usual sources of which are the pelvic organs in the female, the liver, the gall-bladder, and the kidneys, abscesses and inflammations of the abdominal wall, wounds and operative infections. The staphylococcus is not infrequently present, though rarely alone. In peritonitis of uterine or tubal origin, whether puerperal or not, the streptococcus is usually found. Infections after salpingectomies and after hysterectomies show almost invariably the malign influence of this germ. In rare instances erysipelas in the face or in other regions remote from the abdomen has been followed by a streptococcus infection of the peritoneum, the infection taking place undoubtedly through the circulation. Streptococcus infections are usually quite as fatal as those caused by the colon bacillus. At times, though rarely, some forms of the staphylococcus have a similar virulence. As a rule, a peritonitis caused by the commoner forms of pus-cocci pursues a less rapid and fatal course than one dependent upon the colon bacillus or the streptococcus. The success which at times fol-

[1] *Centralblatt für allgemeine Path.*, May 1, 1892; *Ann. de l'Instit. Pasteur*, July 25, 1893; *Arch. de Méd. expér. et d'Anat. path.*, Jan. 1, 1893; Tavel and Lanz, *Ueber die Aetiologie der Peritonitis*, 1893.

[2] *Virch. Arch.*, vol. cxx. p. 7.

[3] *Centralblatt für Path. Anat.*, Oct. 21, 1893.

[4] *Loc. cit.*

[5] *Boston Med. and Surg. Journ.*, 1894, vol. cxxxi. p. 479.

lows the drainage of extensive pus-collections is probably due to this fact. Yet even in infections of this kind the mortality is excessive. Pawlowsky[1] found that death resulted in 18 out of 20 cases in which the staphylococcus was introduced into the peritoneal cavity of animals. Though the course of staphylococcus infections is comparatively slow, in most instances death results. Early operations, however, hold out great promise of success.

The existence of peritonitis due to the pneumococcus is not as yet beyond dispute. This microbe has been found in the peritoneum of a large number of cases of fatal pneumonia, though the peritoneum appeared sound. Nevertheless, cases of peritonitis in which the pneumococcus was beyond a reasonable doubt the cause of the trouble have been reported by Weichselbaum, Curtois-Suffit, Seavestre, Nélaton, and Galliard. From all the evidence it seems that this microbe at times is, and at times is not, injurious to the peritoneum. Morisse[2] collected 8 cases of peritonitis in which the pneumococcus was the only organism; in 7 of these there was either pneumonia or pleurisy; 6 cases died; and 2, both of whom had been operated upon, recovered.

Occasionally a fatal peritonitis occurs under circumstances which the post-mortem examination fails to explain. At the Massachusetts General Hospital two instances of this have recently occurred in which no cause for peritonitis could be found at autopsy. In the literature of the last few years are found reports of such cases, which, for want of a better name, have been called idiopathic, rheumatic, chemical. Irritants have been supposed to be a possible cause for this form of peritonitis, though opinions differ widely on this point. Bumm[3] concludes from experimental work that a plastic non-infective peritonitis can be caused by irritants—chemical, mechanical, or thermal. Other investigators have produced in the same way a certain form of inflammation in animals. In the early exudate of this inflammation neither pus nor micro-organisms could be found, though later, in some instances, it would be filled with micro-organisms. Thompson[4] found that a gauze wad wet in a 1:1000 solution of corrosive sublimate caused in some animals a fatal peritonitis. It has been observed not infrequently that pieces of gauze left accidentally in the abdominal cavity have remained for a long time absolutely sterile. In other instances this accident has been followed by a fatal peritonitis. In these cases, however, it is quite likely that the pressure of a sterile wad sooner or later injures the intestinal wall sufficiently to permit the escape of the colon bacillus. Jelaguier[5] found that a sterile pad can remain and become encapsulated without causing trouble. In the experiments of Ziegler, Pawlowsky, and Reichel sterilized fæces have had no bad effect. Bile is said to be sterile if it contains a normal amount of the biliary acids, yet the injection of unsterilized bile into the abdominal cavity of animals may cause peritonitis. Though blood and urine are usually regarded as sterile, they both make favorable media for germ-growth. On the whole, however, it is probably true, as stated by Treves and many others, that in all forms of peritonitis a micro-organism is the active

[1] *Centralblatt für Chir.*, 1888.
[2] *Peritonité à Pneumococcus.*
[3] *Münch. med. Woch.*, 1889, No. 42.
[4] *Centralblatt f. Gynäkol.*, Jan. 31, 1891.
[5] *Gaz. Hebdom.*, 1892, p. 161.

cause of the inflammation; that the different substances introduced into the abdominal cavity at operations or by extravasations are not absolutely sterile; that certain micro-organisms are present which in the course of time develop in sufficient numbers to cause a distinct infection. Spillman and Ganizetty have collected 15 cases of so-called rheumatic peritonitis, with 9 deaths. The evidence, however, upon which such a diagnosis is based, as Treves remarks, is generally unsatisfactory. In the absence of any demonstrable source of the inflammation the tendency to ascribe it to rheumatism or to some other indefinite cause is great. Peritonitis in connection with gonorrhœa has been observed, though absolute proof is wanting. The association in such cases may be a coincidence, or the disease may favor the development of germs from other sources. Bright's disease, syphilis, and alcoholism are likewise favoring agents. Peritonitis in the new-born is due to infection from the cord or to rupture of the bowel either during delivery or above an imperforate anus.

Hartmann and Morax,[1] in allusion to Bumm's statement that there can be a simple, general, non-infecting peritonitis, report the cases of two women operated upon by them, in one of whom a general serofibrinous and purulent peritonitis was found; in the other, a general injection of the intestine with adhesions. In both cases the cultures were sterile, and in both recovery followed. They think, therefore, that recovery after operation in general peritonitis is due to the absence of micro-organisms. In one case of strangulation by a band general peritonitis, with fluid, was found, but the cultures were sterile—the so-called "chemical peritonitis." In a case of Harrington's, not published, there was a general infection with exudation of serum, lymph-flakes, congestion, and, in fact, all the local and general signs of peritonitis, but the cultures were absolutely sterile. In this and in similar forms the peritonitis would probably be regarded as of the so-called "chemical" origin. A more rational explanation lies in the probability either that the growth of the germ was inhibited by some undetected cause, or that it was one impossible of culture on ordinary media. In such cases the burden of proof rests with those who deny the existence of micro-organisms, for it is probably true that many germs will not grow under any known method of cultivation.

An accurate knowledge of the exact nature of the peritoneal infection can be determined neither from the history nor from the gross appearances: it is wholly dependent upon a careful bacteriological examination. Without such evidence no case can be accepted as one of peritonitis. Doubtless many operative cures have been reported in which no real infection existed. On the other hand, the absence of macroscopic signs of peritonitis cannot be accepted as proving its non-existence. It is therefore essential in speaking of peritonitis to give in every instance the exact bacteriological elements in the case. When, for instance, at autopsies after abdominal operations there are no macroscopical indications of peritonitis, cultures are essential to demonstrate this fact. Doubtless in some fatal forms of peritonitis absorption is so rapid that death takes place before the usual signs have had time to appear. This is undoubtedly true of the more virulent forms of peritonitis. Those

[1] *Annals de Gynécol.*, vol. xli. p. 193, 1894.

due to the milder microbes unquestionably present, long before death, the characteristic signs of peritonitis.

The commonest cause of peritonitis in males is disease of the vermiform appendix; in females, disease of the Fallopian tubes.

Symptoms.—The symptoms of peritonitis vary in their onset with the nature of the exciting cause, appearing suddenly and violently when the invasion of the peritoneum is rapid, slowly and uncertainly when the infection is moderate. When the disease is caused by a sudden perforation of the alimentary canal or by the rupture of a large abscess, by which the whole peritoneal cavity is suddenly infected, the first symptoms are those of shock. Shock is soon followed by collapse. The amount of the shock and the profundity of the collapse vary with individuals and with the extent and rapidity of the infection. Inflammations which spread slowly from a small focus of infection are not usually attended by shock; in rapid and extensive contamination this condition is profound. One of the earliest symptoms of peritonitis is pain. When the extravasation is extensive, pain is severe and lasting; when slight, moderate and transitory. It is generally localized in the beginning, but soon becomes general. Pain is always associated with tenderness. Nausea and vomiting rapidly follow the onset of pain; they are rarely if ever absent. The vomitus, in the beginning consisting of the contents of the stomach, soon shows its intestinal origin, first by the appearance of bile, and later by the presence of the contents of the small intestine. In most instances the material vomited is dark in color, almost black, suggesting coffee-grounds. This appearance is due to hemorrhage from the mucous membrane of the small intestine. When the vomitus is of this color the outlook is extremely grave. Vomiting, at first difficult, soon becomes easy and the patient regurgitates constantly without effort. In favorable cases the vomiting gradually ceases until convalescence is established.

In some instances septic absorption is so rapid that death takes place in a few hours, long before the characteristic signs of the disease are manifest in the peritoneum. In such cases the systemic depression is early and profound, The pulse rises rapidly to 120, 140, 160. The temperature rises excessively, is unaffected, or is even subnormal. The usual signs of collapse become rapidly developed to an extreme degree. Meanwhile the intellect is, as a rule, unimpaired.

In less fulminating cases the pulse and temperature at the outset are moderately disturbed. As the disease progresses both may be affected even to an extreme degree. The character of the pulse indicates the patient's general condition better than any other symptom. The temperature may vary between extreme limits. In some cases of fatal infection the temperature is normal or even subnormal; in other cases it rises to 104° or 105°—though most commonly not above 102° in the morning and 103° in the evening. Just before death the temperature may rise to 106° or 107°, or it may fall below the normal point. Chill, in the writer's experience, is seldom observed in any form of septic peritonitis.

The condition of the bowels is of great importance in general peritonitis. When the infection is extensive, peristalsis is completely overcome, and the resulting symptoms are those of an acute obstruction.

Except in the very beginning of the infection no gurgling or other evidence of peristalsis will be heard. Yet in some forms of general peritonitis peristaltic movements take place throughout the course of the disease. Under such circumstances the infection is probably one of the milder forms, and the prognosis is not absolutely hopeless. When the intestinal wall is completely paralyzed an excessive general distention results. The skin is tight and shining; the resonance everywhere tympanitic. In some of the milder infections the first and chief symptom is distention without pain, fever, or shock. The course is usually a slow one, the infection spreading from coil to coil. Rigidity of the abdominal muscles is an important symptom in the early hours of peritoneal infections. In general inflammations it is general; in local, it is limited to the side affected. It is especially conspicuous in extravasations. Rigidity is usually overcome by distention, and is therefore of value in the early stages only of peritonitis. Lividity of the skin over the abdomen is often present. It is dependent upon enfeebled circulation with profound sepsis, and is a most ominous sign.

In the early stages of practically all cases of general peritonitis there is a serous exudation. If the patient lives long enough, this exudate becomes purulent. The fluid, whether serum or pus, is rarely sufficient in amount to give definite signs on percussion. In exceptional cases dulness will be noticed in the flanks.

Diagnosis.—The symptoms of general peritonitis, taken together, are very characteristic, yet no disease shows greater variation from a typical course. Any of the cardinal symptoms may be absent or all of them. It is therefore possible that at times the identity of the disease will not be established until the autopsy is made. When there is reason to fear a general infection, a significant symptom is vomiting. This may be the first symptom, and throughout the course of the disease the most persistent and distressing one: the patient, too weak to clear his pharynx, may even die strangled in his own vomit. The value of pain as a diagnostic symptom must not be overrated. Though it is generally present, at times it will not even be mentioned. Pain, even severe in character, does not necessarily indicate peritonitis, nor does it follow that peritonitis does not exist because pain is absent. Nevertheless, complaints of pain should always suggest the possibility of an incipient infection. When at the same time there is distention and vomiting, with general tenderness, the diagnosis is almost certain. If, in addition, the constitutional effects of sepsis are evident in the pulse and in the temperature, the presence of the disease is clearly established. Nevertheless, all these symptoms may exist without a general infection. The pain may be peristaltic; the distention may be from gas and transitory; the vomiting, the rise of pulse and of temperature may be dependent upon other causes; and the constipation may be due to opium. The diagnosis at times cannot be fully determined until impending death proves the existence of a hopeless infection.

The symptoms and diagnosis of general peritonitis cannot be thoroughly understood until the subject has been much more fully studied. No disease presents such varying features, for it may depend upon any one of a great variety of micro-organisms, each differing from the others

in physical characteristics and poisonous qualities. Some of them are as yet but imperfectly understood. Doubtless many of them are still undiscovered. Moreover, the symptoms are influenced by the powers of resistance in the patient, the peritoneum having in some individuals a greater tolerance than in others. In one case absorption is rapid, in another slow; in one its effects are immediate, in another remote. Whatever the nature of the micro-organism and the strength of the patient, a general peritonitis, once fully under way, shows itself by signs which can rarely be mistaken. Functional disturbances of the intestines, accompanied by pain, distention, and vomiting, may be mistaken for the beginning of a general peritonitis, although the absence of constitutional symptoms will usually prevent a mistaken diagnosis of peritonitis. Moreover, the favorable course of functional disorders will soon determine the nature of the affection. Between acute general peritonitis and acute intestinal obstruction the distinction is much more difficult, for the symptoms of the two conditions do not differ widely. In both there are pain, distention, and vomiting. The bowels are constipated from the beginning in acute obstruction. When the lesion is above the ileo-cæcal valve, however, the contents of the large intestine may be evacuated and give rise to error. In peritonitis fecal movements may take place in the early stages, and in rare instances throughout the course of the disease. As a rule, constipation is absolute in both diseases. The pain of acute peritonitis depends upon a different cause than that of acute obstruction. In the former it is severe and persistent; in the latter, violent and paroxysmal. In peritonitis it usually starts in the epigastric or in the umbilical regions, and becomes general later. In obstruction it is referred to the vicinity of the lesion. It is intermittent and paroxysmal, gradually increasing in severity. In the early stages of acute obstruction the temperature is not affected; in peritonitis it is generally elevated; in both conditions the pulse is accelerated. When a general peritonitis follows an acute obstruction a differential diagnosis is often impossible, although the history may point strongly to the cause of the general infection. Many of the lesions of acute obstruction in themselves produce a general peritoneal inflammation—lesions which result in necrosis of the intestinal wall. In cases which have not been observed in their early stages the original symptoms of obstruction become marked by those of peritonitis. Under such circumstances it is often impossible to determine the original lesion. General peritonitis, slowly developing from a local focus, is much more easily differentiated from acute obstruction than those cases dependent upon intestinal perforation or rupture of abscesses. Most forms of acute obstruction come on suddenly. Their symptoms, therefore, do not differ from those of a general peritonitis from intestinal perforation. In addition to the early signs, above mentioned, by which acute obstruction is distinguished from general infection, the different causes of obstruction present at times signs sufficiently characteristic for their recognition. In intussusception we find a tumor with bloody stools; in volvulus, in mesenteric thrombosis, and in embolisms, in obstruction from bands, new growths, and hernias, we frequently find distended coils. Yet in all these forms of acute obstruction tumors, resistant coils, and other physical signs may be masked by distention. Under such perplexing conditions surgery offers, fortu-

nately, a means of exact diagnosis. Little time need be lost in idle speculations when acute abdominal symptoms, whatever their cause, clearly demand intelligent exploration.

Treatment of Acute General Peritonitis.—The medical treatment of acute general peritonitis depends chiefly upon the use of opium or of cathartics. Until recently opium has been the remedy most frequently employed in the treatment of this formidable disease. The benefits secured by its use are the lessening of pain and the occasional control of vomiting. A further advantage formerly claimed for the use of opium was the state of rest which it gave the inflamed intestinal surfaces. As long as the idea prevailed that active peristalsis increased the spread of inflammation the use of opium was certainly indicated. With the recognition of the fact that the chief danger in this disease is dependent not upon the local inflammation, but upon the absorption of its products, the theory of providing by abundant cathartics an immediate outlet for these products through the intestinal canal found a successful application. The use of cathartics that produce abundant watery evacuation would relieve distention, promote absorption of peritoneal exudations, and eliminate ptomaïnes; the use of opium would increase distention, prevent absorption of exudates and the elimination of ptomaïnes. The theory of intestinal drainage, carried out by Tait some years ago, has found a general acceptance throughout the surgical world. With certain limitations this method seems the most rational and efficacious of all the medical means thus far employed. In some forms of peritoneal inflammation, especially in the early stages before vomiting has become uncontrollable, free cathartics will often relieve the incipient distention and have a beneficial effect upon the course of the disease. On the other hand, in fully-established general peritonitis with distention and vomiting salines nauseate the patient, reduce his strength, fail to produce catharsis, and, in fact, do more harm than good. Indeed, most observers doubt whether salines have any beneficial effect upon the course of a fully-established general peritoneal infection. Furthermore, when the symptoms of an impending affection disappear rapidly and entirely after free saline catharsis, they question whether any infection really existed. Of the two methods, however, that of free catharsis seems the more reasonable and the more efficacious. Its use should be limited to those cases in which no perforation of the intestinal canal is probable, for if a perforation exists the extravasation of liquid fæces is increased, and an infection up to that point local may become general.

Many surgeons condemn the use of opium in all forms of peritonitis. This rule seems too sweeping. Opium is of great service at times, especially after laparotomy. The pain so common after abdominal operations by preventing sleep rapidly reduces the patient's strength. A small dose of opium will not only stop the pain, but will quiet the patient and promote sleep. At times moderate doses of morphia will control vomiting when nothing else will. The use of opiates should be confined to these indications. Saline or other cathartics, to cover the theoretical grounds of their use, should be given with the first evidence of infection, and before vomiting becomes prominent. Drachm-doses of saturated solution of Epsom salts may be given every hour until abundant watery evacuations are produced. When in a general infection there

is constant regurgitation salines are of no avail. In their place small doses of calomel, frequently repeated (one-fifth of a grain every hour), will sometimes produce free catharsis without increasing the vomiting. Moreover, the calomel often has a soothing effect upon the stomach itself.

In the consideration of the surgical treatment of acute general peritonitis indications for interference are much more difficult to determine than methods. A rule requiring operation in every case is very simple and easy to follow. Unfortunately, many cases come under observation in which a laparotomy takes away the slight chance remaining of recovery. With rare exceptions, all cases of acute general peritoneal infection are fatal, whether treated by opiates, by salines, or by irrigation. Yet at rare intervals free incisions and abundant irrigation are followed by recovery. Doubtless the surgeon's personal experience influences him greatly in deciding the question of interference. When he has seen fifty or a hundred cases of general peritonitis prove fatal, no matter what the treatment, he looks upon the value of active interference with grave doubt; he is inclined to discontinue surgical efforts in the treatment of the disease and to resort to those measures which simply relieve suffering.

Although laparotomy with irrigation is so hopeless a procedure in fully-established peritoneal inflammation, it cannot be said that it is of no use in the early stages of the disease. Unfortunately, circumstances beyond the control of the surgeon prevent him from applying early the proper remedy. Valuable time is doubtless lost by treating peritonitis medically, and the surgical remedy is consequently postponed until its chances of success are gone. If the abdominal cavity could be opened at the very beginning of general infections, the results would doubtless be much more encouraging than they are now.

Besides the indications for interference seen in general infection, most of the causative lesions in themselves demand surgical treatment at the earliest possible moment. With some of these lesions a general infection is coincident; with others it appears at the end of a few days. The former class, to which belong sudden intestinal extravasations and ruptured abscesses, demands treatment for the peritonitis as well as for the causative lesion. The latter, comprising intussusceptions, twists, internal strangulations, thromboses, and embolisms, presents characteristic indications for operation some days or hours before the development of a general infection. Both classes require early interference to be successful; in fact, operative measures cannot be applied too early. Hence the indications in favor of immediate operation are clear, even if the diagnosis between an acute general infection and a mechanical lesion is uncertain. All acute abdominal lesions justify exploration; many of them demand it.

In general infections following abdominal operations the wisdom of interference has been questioned. In point of fact, surgical treatment is as strongly indicated in operative infections as in infections from other causes. Moreover, the common objections to opening the abdomen do not apply. Here, again, the hopelessness of general peritonitis probably influences many operations against renewed explorations. Homans has washed out the abdomen in such cases many times unsuccessfully, and

regards the procedure useless. Many other operators have had a similar experience, yet there seems to be no good reason why the same attempts at surgical relief which are applied to peritonitis from other causes should not be applied also to peritonitis of operative origin.

A serious objection to surgical interference in the early stages of infections of doubtful extent is that by stirring up the intestinal coils, which perhaps have already formed effective barriers against further spread of the disease, the surgeon converts a local into a general peritonitis. The force of this objection is illustrated in the early hours of an acute appendicitis, when it is uncertain whether the infection is localized or is spreading. If the extension of the disease has been checked by the efforts of the peritoneum—a condition at times hard to determine—interference breaks down the feeble barriers and converts a local into a general infection. In doubtful cases the danger from the rupture of adhesions is overbalanced by the danger from delayed exploration. In cases of uncertainty, therefore, the indications favor exploration. When the infection is evidently local and its constitutional effects moderate, delay is not only justifiable, but on the whole preferable.

When the whole abdominal cavity is so seriously affected that the outlook seems hopeless the wisdom of interference may well be doubted. Though the case may seem beyond relief, there yet remains a chance which the slightest surgical manipulation will take away. Under such circumstances a policy of non-interference is strongly indicated, as giving the patient his only chance of recovery, small though it may be.

The statistics bearing upon the question of operative interference vary between such extreme limits that their value is often questioned. General peritonitis is essentially so hopeless a disease that a large percentage of recoveries under any form of treatment raises doubt as to the correctness of diagnosis. Koerte[1] believes that most of the brilliant statistics of cures of acute general peritonitis by operation are false—that on analysis they prove to be mainly cases of local abscess. Stuehlen, for example (Strasburg, 1890), collected 78 cases with 50 recoveries; Zanz (Berlin, 1891), 30 cases with 10 recoveries. When general peritonitis in the hands of experienced men proves almost invariably fatal under every known method of treatment, such percentages of recovery as those just given seem incredible. Mikulicz before the Eighteenth Congress of German Surgeons reported 14 cases of peritonitis with only 3 recoveries; Koerte, 19 cases with 6 recoveries. Krecke,[2] commenting on a collection of 119 cases with only 68 deaths, shows that such statistics are false, and that the diagnosis in most cases is not correct. Halsted expresses the same views and regards the disease as excessively fatal. My personal experience with peritonitis has been so unfavorable that even the statistics of Mikulicz (3 recoveries in 14 cases), of Koerte (6 recoveries in 19 cases), of Halsted (only 2 recoveries at the Johns Hopkins), seem very encouraging. In a large number of cases of general peritonitis, verified by bacteriological demonstration, the result, with hardly an exception, has been fatal in my hands under any method of treatment.

The operation for general peritonitis consists in free incision and

[1] *Archiv f. klin. Chir.*, vol. xliv. p. 612.
[2] *Münch. med. Woch.*, 1891, Nos. 33 and 34.

drainage, with or without irrigation. The abdomen should be opened in the median line below the umbilicus, unless some other seat of incision is indicated by the original lesion. For drainage alone the cut should be short; for thorough irrigation it should be long. Satisfactory drainage of the peritoneal cavity is practically impossible, especially when the intestines are distended. The most efficient method is by means of gauze wicks placed in the pelvis and in each flank. Glass or rubber tubes may also be used in combination with the gauze. Dependent drainage is best secured by incision through each flank.

Irrigation should be used in all general peritoneal infections if the patient's strength permits. Irrigation is recommended by some, even if the general condition is bad, on the ground that the warmth of the solution relieves shock and revives the strength.

Various solutions have been recommended for irrigation. The weight of authority is in favor of sterilized warm water or of salt solution. Peroxide of hydrogen is strongly recommended by Senn and Morris. Sterilized water or salt solution at the temperature of the body should be used in large quantities. It may be carried to the remotest corners of the abdominal cavity by means of a perforated glass tube with blunt end, through which, attached to a rubber tube and funnel, unlimited quantities of fluid may be passed.

After thorough irrigation the dependent parts of the peritoneal cavity—the pelvis and the flanks—should be carefully dried by means of gauze. Capillary drainage may be employed through gauze wicks placed in the pelvis and in each flank, and brought out either through the abdominal wound or, by incision, through the back.

Some surgeons maintain that irrigation only spreads the infection. Reichel opposes the method for this reason, and also because it is impossible to cleanse thoroughly the intestines. In experiments on dogs with ten to fifteen litres of water he found it impossible to wash the intestines clean. Though it is doubtless true, as Halsted has observed, that thorough drainage and disinfection of the abdominal cavity is impossible, yet imperfect drainage and disinfection is certainly better than none at all. The objection on the ground that irrigation spreads the infection holds in cases of localized peritonitis, but not in cases in which a general infection already exists. Another objection to prolonged irrigation is that the natural absorptive power of the peritoneum is thereby destroyed. It is impossible to say how much scientific foundation there is in this objection, but from a practical point of view it would seem that the natural powers of the peritoneum would suffer quite as much from the continued presence of a poisonous exudation as from a bland and sterile solution.

Anatomically, it is practically impossible to drain thoroughly the peritoneal cavity. The spaces between the numerous intestinal coils cannot be reached with the irrigating fluid, especially when distention exists. The most that is accomplished is the superficial cleansing of the presenting coils, with drainage of the pelvis and the flanks. On the other hand, if it is difficult to reach remote recesses of the peritoneum to complicated coils, it is also difficult for the infection to extend to these remote places. Irrigation, therefore, cleanses those regions of the abdomen most liable to be contaminated, and, although it does not wash off

every coil, it removes effectively the septic exudation which gravitates into the flanks and into the pelvis.

Objections have been raised to every method of treatment, medical and surgical, in general peritonitis. They are all founded upon the hopelessness of the disease. Our efforts should not be relaxed, however, because of the essentially fatal nature of this affection. Early recognition, early operation, and improved technique will undoubtedly result in a greatly lowered mortality.

Our knowledge of acute and general peritonitis and of its treatment is still very incomplete, especially as to the influence of micro-organisms upon its course. Statistics in this disease are of little value if they do not rest upon competent bacteriological examination.

The prognosis in general peritonitis, under any method of treatment, is extremely grave, as has been already stated in connection with symptomatology and treatment.

Perforation of Typhoid Ulcer.—Among the forms of general peritonitis hitherto regarded as hopeless are perforations of ulcers in typhoid fever. This form of extravasation, occurring in the course of a formidable constitutional disease, adds so grave a complication that surgical interference has been deemed out of the question. Under such circumstances the only chance of recovery has been universally supposed to lie in the formation of adhesive barriers by the spontaneous efforts of the peritoneum. In recent years, however, attempts have been made to remedy by early exploration this deplorable condition.

Intestinal perforation in typhoid fever is of very rare occurrence. Fitz[1] found in 4680 cases, collected from various sources, a mortality of 6.58 per cent. from perforation. The accident occurs most frequently in men, rarely in children. Perforation may take place at any time from the first to the sixteenth week. The seat is in the ileum in 81.4 per cent., in the large intestine in 12.9 per cent. In 167 cases Fitz found that 5 were perforation of the vermiform appendix, 4 perforation of Meckel's diverticulum, and 2 perforation of the jejunum. In 19 cases there were two perforations, in 3 there were five, in 1 there were four; in 1 case there were twenty-five to thirty holes; in another there were thirty.

There seems to be no definite relation between the severity of the fever and the occurrence of perforation. In one-fourth of nearly two hundred cases the course of the disease was stated as mild.

Perforations in the course of typhoid fever may be unrecognized, and therefore unrecorded, for the symptoms are often obscure. On the other hand, peritonitis from other causes occurring during the course of typhoid fever has been erroneously attributed to the latter. Fitz mentions other causes of peritonitis in typhoid: (1) acute intestinal obstruction, (2) softened infarcts of the spleen, (3) softened glands, (4) abscesses in the wall of the bladder, (5) ovarian abscesses, (6) perforating ulcers of the gall-bladder, (7) abscesses of the liver, (8) rupture of the spleen, (9) salpingitis, (10) endometritis. Moreover, fatal cases of peritonitis in the course of typhoid fever are numerous in which no local lesion is found.

Peritonitis from the perforation of typhoidal ulcers does not differ

[1] *Trans. Assoc. Amer. Physicians*, 1889-91, p. 200.

materially from peritonitis dependent upon other intestinal perforations. The original disease is quickly masked by the peritoneal complication. Hence other intestinal lesions have been mistaken for typhoid fever, especially in cases that come under observation later. Appendicitis has probably been many times erroneously regarded as typhoid fever.

The local conditions seen in typhoid ulcerations do not differ materially from those in ulcerations in the alimentary tract from other causes, except in the rapidity of their course. As the ulcerative process approaches the peritoneum adhesive inflammation makes barriers against extravasation, so that a general peritonitis is prevented and recognition of the lesion is impossible. Doubtless many perforations which are never even suspected take place from one coil into another. In other cases barriers against extravasation are feeble and ineffectual. Even if firm enough, under ordinary circumstances, to restrain extravasation, they may give way under an unusual intestinal or bodily strain. If due to excessive distention, the extravasation, aided by coughing or vomiting, is likely to be excessive and flood immediately the peritoneal cavity. Perforations from simple extension of the ulcerative process are slower and more likely to be effectively barricaded.

The mortality in typhoidal perforations depend upon the rapidity and the extent of the extravasation, the competence of the resisting barriers, the severity of the constitutional disturbance, the strength of the patient, and the method of treatment. Extravasations so moderate that the peritonitis is local, and possibly unrecognized, frequently recover with the formation of permanent adhesions. When the fecal extravasation is rapid and abundant the resulting general infection is also, without exception, fatal under palliative treatment. A few brilliant operative successes in these general infections, though not materially affecting the general prognosis, make the outlook less discouraging.

Prognosis.—If our knowledge in this direction can be extended, so that either the impending accident may be anticipated or its actual occurrence immediately recognized, surgical interference in the first hours may result in a decided improvement in the prognosis.

The severity of the original disease also influences profoundly the prognosis. When constitutional depression is severe the outlook is especially bad. In mild cases the gravity of the exploratory operation is not greater than in many other abdominal conditions hitherto regarded as hopeful. Comparatively simple operations, undertaken in the course of a severe constitutional disease like typhoid fever, have a mortality out of all proportion to that of the operation itself under favorable conditions. Cheever, in a discussion on Mears' paper on this subject before the American Surgical Association, vol. xi. p. 433, 1888, with great clearness called attention to this point.

Symptoms.—The symptoms of perforation are often so obscure that it is impossible to recognize definitely the condition. When perforation takes place so slowly that adhesive barriers prevent a general extension of the inflammation, symptoms are either wanting or are those of distinct localization. The symptoms of a gradual perforation are often masked by those of the fever itself. Pain and tenderness of moderate severity, occurring suddenly in the course of typhoid fever, without shock or distention, vomiting or obstipation, should always suggest the limited peri-

tonitis of a slight extravasation, especially if the pain and tenderness are localized and if the circumscribed tumor with dulness or tenderness can be detected. Though we should not be expected to see in perforation of this kind the systemic depression of a general peritoneal invasion, yet we should doubtless find an acceleration of pulse and a rise of temperature. The symptoms of perforations with extensive infections in typhoid fever are those of general peritonitis from other lesions attended by fecal extravasation. Intestinal perforations occurring in the course of an acute septic disease are attended by immediate systemic depression of an extreme type. In cases of mild typhoid, however, the immediate constitutional effects of the extravasation may not exceed those occurring in the course of other septic diseases—*e. g.* in the rupture of abscesses, in perforations of the vermiform appendix, and in the rupture of septic and inflamed viscera. In rapid extravasations the symptoms of general peritonitis already described will be present—local pain and tenderness rapidly becoming generalized, distention, vomiting, constipation, with shock and collapse.

Prognosis.—Distinctly localized inflammations may disappear spontaneously or they may result in circumscribed abscesses. Spontaneous cure of abscesses may take place by rupture into the intestine. They may break into the general peritoneal cavity and cause a general peritonitis; they may become encapsulated and by degrees be absorbed; evacuated surgically, they may follow the usual course of abdominal abscesses; finally, without either spontaneous or artificial opening, they may cause death by exhaustion.

Cases of fully-established general peritonitis from the perforation of typhoid ulcers are almost without exception fatal under any treatment, medical or surgical. The prognosis in general infections treated by prompt and thorough operation is, to say the least, encouraging.

The treatment of typhoidal perforations may be palliative or radical. Our knowledge of the subject up to the present time justifies immediate laparotomy in certain forms, and contraindicates interference in others.

General perforative peritonitis of typhoidal origin should be treated on the same principle as general infections from other sources. Exploration should be made only when the constitutional condition is promising. When shock is great and collapse profound surgical interference is not warranted. In doubtful cases the inclination, for the present at least, should be on the side of conservatism. Operative treatment offers the best chance when applied in the first hours of the infection if shock is mild and if the general strength is unimpaired. Even if the occurrence of perforation and extravasation is doubtful, symptoms strongly suggesting this accident in a vigorous patient justify exploration.

If a perforative peritonitis of typhoidal origin is recognized while the patient's strength is good, surgery undoubtedly offers the best chance for recovery, slight though it may be; hence the first distinct symptoms of perforation that appear in the course of typhoid fever demand immediate exploration. All authorities agree that surgical interference, to be of avail, must be practised immediately, without waiting for the appearance of a general infection.

Localized abscesses of typhoidal origin should be treated by incision,

irrigation, and drainage, like abdominal abscesses from other causes. Great care must be taken that the adhesive barriers are not broken down by the manipulations of this operation, to avoid converting a local into a general infection.

When the infection is general the incision should be made over the seat of the initial pain, if that can be accurately determined. When the signs do not point to a definite spot, the cut must be made in the median line, above or below the umbilicus according to the predominance of symptoms. The general principles of exploration in peritonitis should be followed. The opening must be large enough for rapid and easy examination and for effective irrigation. By a brief manual examination the seat of the lesion may generally be determined; if not, the coils should be rapidly and systematically inspected. As soon as the perforation is found it should be closed by infolding the peritoneal surfaces, by excision of the ulcer, or by resecting the coil. The whole affected region should be examined, for more than one perforation may exist. When, by one means or another, all the lesions have been repaired, a general irrigation with warm water or with normal salt solution should be employed. Abbe in his successful case used a hot solution of corrosive sublimate, 1 : 20,000. Tampons of iodoform gauze were left in the abdominal wound. Drainage may be made through the flanks as well as through the abdominal wound. If the distention is excessive and the patient's condition good, the intestinal coils may be punctured or incised. In most instances, however, the shock from the additional manipulation will more than balance any good to be expected from it. When the patient's condition is so bad that a prolonged operation is likely to be fatal, the edges of the perforation may be stitched to the abdominal wound, as recommended by Bland Sutton.[1]

Statistics of Operative Cases.—Mears[2] in reviewing this subject found 14 cases operated upon up to 1888. Bland Sutton[3] reports a case in a man of twenty-five with perforation on the twenty-fourth day in a mild attack of typhoid. The ulcer was excised five and a half hours after the perforation, the wound closed, and the peritoneal cavity thoroughly irrigated. The patient recovered from the operation and died in a typhoid state on the sixth day. Sutton says that in another case he would hastily wash out, and stitch the edges of the perforated ulcer to the abdominal wound, because a long operation influences the prognosis very unfavorably. Allingham, in the discussion of Sutton's paper, reported a case of his own in which death took place in twenty-four hours.

The cases of operation for typhoid perforation up to the present time have been collected by Abbe, as follows:

1884. Mikulicz, 4 cases; 1 recovery; diagnosis doubtful.
1885. Leucke, 1 case; resection; death.
1886. Escher, 1 case; recovery; probably appendicitis.
1886. Greig-Smith, 1 case; death; doubtful diagnosis.
1886. Bartlet, 1 case; death; regarded as doubtful by Fitz.
1887. Bontecou, 1 case; death.
1889. Senn, 1 case; death.
1889. Hahn, 2 cases; death.
1890. Kimura, 1 case; death.

[1] *Lancet*, March 17, 1894. [2] *Trans. Amer. Surg. Assoc.*, vol. vi. [3] *Loc. cit.*

1890. Taylor, 1 case; recovered.
1891. Van Hook, 3 cases; 2 deaths; 1 recovery.
1894. Bland Sutton, 1 case; death.
1894. Allingham, 1 case; death.
1894. Netschagaw, 1 case; recovery.
1894. Abbe, 1 case; recovery.
1894. Alexandroff, 1 case; death.
1895. Watson, 1 case; recovery.

If we accept all these cases, we have 23, with 7 recoveries. If we eliminate the doubtful cases, we have 18 up to December, 1894, with 4 recoveries.

Ulcer of the Duodenum.—The surgical importance of this disease has been recognized and emphasized only within recent years. Prompt interference in perforating ulcer of the duodenum, on theoretical grounds, promises an occasional brilliant result. The chief difficulties hitherto encountered have been due to the impossibility of early diagnosis and to the inherent obstacles to successful operation. In comparison with perforating ulcer of the stomach it is a rare occurrence: the ratio, according to Ewald, is 6 : 225. The post-mortem records of St. Bartholomew's Hospital, covering a period of sixteen years from 1867 to 1882, show only 3 cases of perforating ulcer of the duodenum.[1] According to Shields,[2] an analysis of 8192 cases from the post-mortem records of St. George's Hospital, covering a period of thirty-one years, shows 116 deaths from intestinal perforation, and of this number but 12 were cases of perforating duodenal ulcer—0.14 per cent. of all the deaths and 10.34 per cent. of all intestinal perforations. Of the 12 cases, 10 were males: this predominance in the male sex is seen in all available statistics. It is about three times as common in men as in women, and is usually an affection of young adult life. The etiology and the pathology of this disease may be said to be in general similar to gastric ulcer. Recent writers have called attention to the fact that in many cases it has been associated with albuminuria and nephritis. Perry and Shaw,[3] in their paper on duodenal ulcers, found 12 cases out of 70 associated with Bright's disease. Older writers and pathologists laid great stress on scalds and burns as a cause of duodenal ulcers, but the opinion of recent observers seems to attach much less importance to this factor. Perry and Shaw[4] out of 149 cases of burns found only 5 complicated with duodenal ulcers. It has been suggested by Shields[5] that the explanation can be found in the prevention of sepsis under modern methods of treatment, and that the association of the two lesions frequently noted in earlier years was due to septic embolism originating in an extensive superficial infection. Ulceration of the duodenum in connection with malignant disease is very rare.

Chronic duodenal ulcers may terminate in a variety of ways other than by perforation. Erosion of the pancreas or a large vessel may result in fatal hemorrhage; cicatrization of the ulcer may result in stricture. Adhesions to neighboring parts may cause internal fistulæ.

Diagnosis.—It can hardly be possible to make a positive diagnosis of duodenal ulcer before perforation takes place. The majority of duodenal

[1] Moore, *Path. Soc. Trans.*, vol. xxxiv. p. 98. [2] *International Med. Mag.*, Jan., 1895.
[3] *Guy's Hospital Reports*, 1894. [4] *Loc. cit.* [5] *Loc. cit.*

perforations have been diagnosticated and treated as perforations at other points in the intestinal tract. As diagnostic evidence available in some cases Ewald mentions epigastric pain coming on some time after eating, tenderness decidedly to the right of the median line, and possibly profuse bloody stools with hæmatemesis. In some cases, as also in gastric ulcer, there may have been no symptoms before sudden perforation and death. All the cases in which surgical treatment has been adopted have been operated upon under an erroneous diagnosis. Shields[1] reports two fatal cases, both in young males, operated on for perforation of the appendix; in both the lesion was a duodenal perforation which was not found until after death. Lockwood has cited two cases similar in every feature.

In perforative peritonitis it may be concluded that no symptoms point definitely to the duodenum, but the possibility of the cause being a perforating duodenal ulcer, especially if the case is in a young adult male, must be borne in mind. Shields states that if, after opening the abdomen in a case of peritonitis from unknown cause, the exudation is non-feculent, and especially if it is acid, the stomach and the duodenum should always be explored.

The treatment of duodenal ulcers on theoretical grounds does not differ from that of ulcers of the stomach and ulcers of the intestine (*q. v.*). The anatomical position of the duodenum, with the situation of the *ductus choledochus communis*, makes operative interference unusually difficult. No cases of radical surgical treatment for this condition have been thus far recorded.

Tubercular Peritonitis.—Tubercular peritonitis, until recently regarded as a hopeless affection, is by no means uncommon, though one of the more infrequent diseases of the peritoneum. It is frequently met with in children, though it is most common between the ages of twenty and forty. Statistics from post-mortem reports prove that this disease is more frequent in males, but the majority of cases operated upon are females. Of 134 operated cases collected by König,[1] 120 were women and only 11 men. Of 107 cases discovered on the post-mortem table, 89 were men and 18 women. The predominance of this disease in the female sex has been explained by the tendency to tuberculosis of the genital organs, and especially of the Fallopian tubes; also by the fact that women in general come to operation earlier and more frequently than men.

Surgical interest in tubercular peritonitis began in 1862 with the celebrated case of Sir Spencer Wells. In this case the abdomen was opened under a mistaken diagnosis, tubercular peritonitis was found, and the incision was closed. The recovery of this patient after a simple exploratory operation instituted the surgical treatment of the disease. Petri in 1874 performed similar operations, and König in 1884 reporting 3 cases advocated laparotomy as a routine method of treatment.

Although tuberculosis may occasionally be primary in the peritoneum, in the majority of cases it is secondary to tubercle elsewhere—in the pleura, the lungs, the intestines, the reproductive organs, the mesenteric and retroperitoneal glands. According to Sicks' statistics,[2] in 2500 autopsies 25 per cent. of the cases of tubercular peritonitis were found to be secondary to tubercular disease of the genital tract, in comparison

[1] *Centralblatt für Chir.*, 1890, p. 657. [2] *Ibid.*, 1893, p. 447.

with 65 per cent. from the intestinal tract. In children the main source of infection is the mesenteric glands themselves, usually infected through intestinal absorption.

The best classification of tubercular peritonitis is that of Aldibert,[1] according to whom there are three forms of the disease: (1) the ascitic, (2) the fibrous, and (3) the ulcerous form.

1. The ascitic form is by far the most common. It occurs rarely as an acute miliary tuberculosis of the whole peritoneum, usually being a subacute or chronic process. The ascitic fluid is abundant, is rarely sero-purulent, and sometimes is blood-stained. Strong adhesions are seldom present.

2. The fibrous form of the disease has been regarded as a process toward recovery. Ascites may be present, but it is not excessive; the fluid is clear and rarely sero-purulent. In the dry variety large tubercles are found scattered over the peritoneum, without ascites and without adhesions. In the adhesive variety of the fibrous form firm bands and masses of adhesions mat together the coils of intestine.

3. The ulcerous form is caused by the breaking down of the tubercular foci. Two varieties are described by Aldibert, the dry and the suppurative, each representing different stages of the necrotic process. The suppurative form may be general or encysted.

Though it is possible to differentiate pathologically the different forms of tubercular peritonitis, a clinical diagnosis without exploratory operation can only be suspected. The onset and clinical course are often insidious. In some cases the only symptoms are digestive disturbances, progressive emaciation, and slight swelling of the abdomen, with almost no pain; in others the pain is severe, the abdomen extremely swollen and very tender. The onset at times resembles typhoid fever. In a large proportion of the cases no positive diagnosis can be made in the absence of ascites or of an abdominal tumor. It is much easier to make a diagnosis in the ascitic form of this disease than when the lesion manifests itself by invading the mesentery, the omentum, or the lymph-glands, or by matting together the coils of intestine. Tumors of the kidney, cancer of the omentum and peritoneum, appendicular abscesses, internal hernias, salpingitis, and tumors of the abdominal wall may all be simulated by this form of tubercular peritonitis. The ascitic cystic form of the disease must be differentiated from cysts of the ovary, of the mesentery, and of the liver. In many cases a diagnosis without exploratory operation is impossible. Extreme variations of the temperature suggest tuberculosis. When there is neither general abdominal enlargement with ascites nor a localized tumor the diagnosis is still more difficult and can only be suspected.

Aldibert has classified the clinical features of the disease as follows: In the ascitic form the usual symptoms are malaise, fever, headache, vomiting, and constipation, with progressive wasting, a tender and distended abdomen, and ascites; in the fibrous form, an insidious onset, no great impairment of health, and no constant symptom except moderate fever; in the ulcerous form, emaciation, fever, night-sweats, vomiting, and diarrhœa, an enlarged abdomen, with varying areas of dulness and resonance, and with hard masses in some portions and fluctuation in others.

[1] *Thèse de Paris*, March, 1892.

Aldibert[1] collected 308 cases of tubercular peritonitis treated by laparotomy, with the following results:

1. The ascitic form:
   - (*a*) Acute cases, 2; both ending fatally.
   - (*b*) Subacute cases, 18; 7 deaths; mortality, 38.8 per cent.; recoveries, 61.2 per cent.
   - (*c*) Generalized, chronic, 64 cases; 15 deaths; mortality, 23.4 per cent.; recoveries, 73.4 per cent.
   - (*d*) Encysted, chronic, 65 cases; 7 deaths; mortality, 10.7 per cent.; recoveries, 80 per cent., of which 38.4 per cent. were permanent cures.

Summary of 149 examples of the ascitic form: Deaths, 31; improved, 2; stationary, 6; recoveries, 110; total, 149.

General mortality, 20.8 per cent.; mortality due directly to the operation, 2.6 per cent. Most of the deaths followed several days or weeks after the operation and were due to general tuberculosis or to intercurrent disease; general percentage of recoveries, 73.8, of which 35.4 can be regarded as complete cures; 26.17 per cent. of all the cases operated on remained well after one and two years, and are regarded as definite cures.

2. The fibrous form:
   - (*a*) Dry variety, 1 case, which recovered.
   - (*b*) Adhesive variety, 25 cases; 5 deaths.

General mortality in the 26 cases, 19.2 per cent.; percentage of recoveries, 80.8, of which about 40 per cent. may be regarded as complete cures.

3. The ulcerative form:
   - (*a*) Dry variety, 4 cases; 3 deaths.
   - (*b*) Suppurative, general, 6 cases; 2 deaths.
   - (*c*) Suppurative, encysted, 12 cases; 4 deaths.

General mortality in the 22 cases, 40.9; percentage of recoveries, 59.1, of which about a fourth may be classed as complete cures.

4. Tubercular peritonitis arising from the genital organs: 41 cases, 14 deaths.

General mortality, 34.1 per cent.; recoveries, not estimating 4 stationary cases, 56 per cent., of which perhaps a fourth should be regarded as definite cures.

To the above 238 were added 70 cases published without details; among the 70 were 15 deaths.

General summary:

Cases treated by operation	308
Deaths	74
Total mortality	24 per cent.
Mortality directly due to operation	2.5 per cent.
Recoveries	234
Percentage of recoveries	69.7

of which 33.4 per cent. (or 23.05 per cent. of all the cases) may be regarded as permanent cures.

In 50 of the above 308 cases tubercle was demonstrated, either histologically or bacteriologically. Among these are 7 deaths, 39 cures, and 4 examples of non-improvement.

[1] *Gaz. hebdom. de Méd. et de Chir.*, 1892, No. 19, p. 218.

Roersch[1] to this series of 308 cases has added 50, giving a complete analysis of 358 cases. Of these, 70 per cent. (250) are reported as cured; 53 remained cured for over two years, 79 for one year, and 118 for half a year; 34 remain unaccounted for. There were only 20 deaths from the immediate effects of the operation, 10 of which were from septic peritonitis; 51 cases died in a few months from some tubercular affection. Frees has reported 18 cases operated on since 1888. The diagnosis of the disease was made from microscopic examination of the nodes. All the cases were of the ascitic form. The immediate mortality was 0; 6 of the 18 cases have remained well; 9 died before the end of the first year.

Frees[2] insists that a diagnosis of tubercular peritonitis should never be made without the microscope. In support of this he cites two cases which proved to be non-tubercular; one was simple fibrous peritonitis, the other cancer of the peritoneum.

Medical and palliative treatment is necessary in the presence of hopeless lesions, whether tubercular or not, in other parts of the body. The operation is also inadvisable when the disease exists in an acute miliary form. When there is localized peritoneal infection and a general matting together of the intestinal viscera, with external and internal fistulæ, operation is not indicated, especially if the patient's general condition is bad. In the palliative treatment of tubercular peritonitis reliance must be placed upon the food, tonics, changes of climate, etc. The operative treatment must vary with the form of the disease. Repeated aspirations of the abdomen are not only of little avail, but are not without danger of hemorrhage and extravasation. The simple ascitic form, the most frequent and probably the most important, should be treated by free incision and thorough removal of the abdominal fluid. The incision should be made in the median line, between the umbilicus and the pubes, and should be large enough to permit free exploration and efficient drainage. When distinct changes are noticed in the peritoneum, further incision must be made with the greatest care to avoid cutting directly into the adherent bowel. This accident, by no means infrequent, adds a serious complication to the operation.

The fluid should be entirely removed; that which cannot be pressed out should be removed by means of gauze sponges. If drainage is employed, openings may be made in each flank as well as in front. As soon as the ascitic fluid has been evacuated the abdominal cavity may be irrigated with water or with chemicals. Many authorities, however, oppose both irrigation and drainage on the ground that the former is unnecessary, the latter impossible, and that statistics show in this form of tubercular peritonitis more favorable results from simple incision and evacuation. According to Aldibert, this variety, treated by irrigation, shows 72.5 per cent. of cures; not treated by irrigation, 74.3 per cent. Relapses are as common in the cases drained as in those not drained. Drainage, if employed, should be by means of gauze rather than of drainage-tubes, for the latter may by ulceration into the bowel cause fecal fistula.

Sterilized water, salt solution, carbolic acid, iodoform, and iodine have been used for irrigation, but the best results on the whole have followed

[1] *Revue de Chir.*, 1893, No. 7. [2] *Deut. med. Woch.*, 1894, No. 45, p. 849.

simple incision without either flushing or drainage. If drainage is used, it should be removed within a few days to prevent the formation of a sinus. After the closure of the wound a tight abdominal bandage should be put on.

The encysted variety of tubercular peritonitis requires simple incision and evacuation without drainage. According to Aldibert's statistics, in 149 cases of operation for the ascitic form there were 14 relapses: 3 were in children, and were ultimately cured; 11 were in adults, of whom 1 died, 3 remained stationary, and 7 recovered. The percentage of relapses, therefore, in the total (149) is only 9.4. In 5 of the relapsing cases in adults a second laparotomy was performed. Of this number 1 died, 2 were cured, and 2 remained unrelieved.

Tubercular peritonitis, without ascitic fluid, in which there are adhesions, demands interference as strongly as the ascitic form. Many surgeons oppose operation on the ground that the disease is progressing toward a spontaneous cure. On the other hand, exploration may reveal localized collections of fluid, the removal of which may hasten cure. Great care must be taken in operating upon this form not to break down the adhesions. In that form of the disease in which the intestines are matted together and in which there are numerous foci of pus, the operation is generally contraindicated on account of the great danger from the extensive manipulations necessary. Such localized collections of pus, if they can be made out, should be drained. The indications, however, should depend upon the circumstances of each case. Tuberculosis localized to special regions of the intestinal tract, as the ileo-cæcal coil and retroperitoneal glands, may be treated by operation or not according to the general condition. Tuberculous infiltrations causing stricture require excision and suture or the formation of an artificial anus. When the mesenteric or retroperitoneal glands are extensively infected, attempts should be made to remove them. Very few operations of this kind have been performed: 4 have already been referred to; a fifth case, in my own experience, has thus far resulted favorably. In this case a large mass of tubercular glands was found in the mesocæcum, extending up toward the spine in nodes gradually decreasing in size. There were irregular fever, abdominal uneasiness, diarrhœa, moderate distention, and a localized tumor supposed to be appendicular. This form of peritoneal tuberculosis, usually regarded as practically hopeless, offers apparently a rich field for investigation. The removal of tubercular glands of the mesentery by laparotomy in some cases is not difficult. A local and defined mesenteric infection, threatening a general tubercular peritonitis or tubercular metastases, can be entirely removed by an operation which at the same time may afford relief in the obscure way seen in cases of the ascitic variety treated by simple incision.

Pic[1] has made the following estimate of the prospects of a patient suffering from the ulcerous variety of tubercular peritonitis: Of children treated without operation, one-third recover; of adults treated without operation, one-fifth recover; of the cases treated by operation, four-fifths recover.

Many theories have been advanced to account for the recoveries in tubercular peritonitis after simple incision. The cures that followed in

[1] *Thèse de Lyons*, 1890.

the beginning of simple explorations were as much a matter of surprise as they are now a matter of conjecture. Some think that recovery is due to the combined action of light and absence of moisture; others, that the entrance of air into the abdominal cavity accomplishes the cure. On the latter theory some cases have been reported as cured by sterilized air pumped into the peritoneal cavity. Some think that recovery is due to the escape of ptomaïnes and of the products of bacterial growth; others, that the relief of intra-abdominal pressure promotes more rapid circulation and germ-absorption. Whatever the cause may be, it is essential that a free incision should be made for the admission of air and of light, and for the free escape of fluid.

The permanence of reported cures after free incision in tubercular peritonitis is often questioned, the good results being regarded by many as of temporary duration. Though many of the recorded cases are so recent that it is impossible to say that recovery is permanent, the weight of evidence points strongly to a large percentage of permanent cures, especially in the ascitic form, after an operation the mortality of which in itself is trivial.

Surgery of the Pancreas.

Wounds and Injuries.—The pancreas, deeply situated in the abdomen, is rarely the seat of injuries except from penetrating wounds. Moreover, the pancreas is seldom injured without serious complications to contiguous important viscera. It has never been found ruptured from abdominal contusions without accompanying rupture of the liver and kidneys. Prolapse of the pancreas through penetrating abdominal wounds has undoubtedly occurred. A case of this kind has been mentioned by Nussbaum.[1] A similar one has been reported also by Laborderie,[2] in which recovery followed excision of the prolapsed portion. Senn[3] adds five other cases.

The diagnosis of injury to the pancreas can usually be made only by laparotomy. Violence sufficient to cause definite injury to the pancreas is so complicated by grave lesions of other organs that a diagnosis of general abdominal injury is the only one that can be made. Though contusion and laceration of the pancreas itself are not necessarily fatal, as Senn has shown in his experiments, yet the accompanying injuries in man usually cause death.

Treatment.—Hemorrhage must be treated by ligation of bleeding-vessels, by gauze-packing, or by both. When from contusion or laceration the vitality of the gland is questionable, gauze-packing and drainage are essential as a temporary measure of safety. Necrotic portions of the gland should be removed. When the pancreas has prolapsed through the abdominal wound it may be replaced and held in position by means of gauze. If the vitality of the prolapsed part is compromised, it must be removed.

Inflammation of the pancreas may be acute or chronic. Acute pancreatitis may be hemorrhagic, suppurative, or gangrenous. Chronic inflammations of the pancreas are usually interstitial. Acute hemorrha-

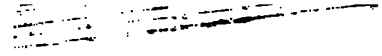
[1] *Die Verletzungen des Unterleibes*, 1880.
[2] *Gaz. des Hôpitaux*, 1856, No. 2.
[3] *Trans. Amer. Surg. Assoc.*, 1886, vol. iv.

PLATE III.

Disseminated Fat Necrosis in the Mesentery of the Small Intestine. (This illustration is taken from the same patient as that of Plate IV.)

PLATE IV.

Hemorrhagic Pancreatitis, from a woman fifty-two years old. Death after a few days' illness. Chief symptoms were epigastric pain, vomiting, and digestive disturbances. In addition to the extensive inflammation and hemorrhage, as shown in the plate, there were extensive foci of fat necrosis about the pancreas, and small disseminated areas throughout the peritoneum, especially along the border of the mesentery at its attachment to the intestine. (See Plate III.)



gic pancreatitis is of great surgical interest, because at times it gives rise to symptoms which are mistaken for those of perforative peritonitis or of acute intestinal obstruction. Our knowledge of this disease is mainly due to Fitz.[1] It is very seldom possible to make the diagnosis before death, though the lesion has been demonstrated by exploration undertaken under a mistaken diagnosis, as in Kraft's case,[2] in which a gastric ulcer was supposed to exist. In one case a correct diagnosis was made by Fitz shortly after the publication of his Middleton-Goldsmith Lectures on the subject. The symptoms of acute hemorrhagic pancreatitis are those of acute intestinal obstruction or of acute general peritonitis—sudden violent pain coming on without known cause, persistent and continuous vomiting, distention, general tenderness, and constipation. Fever may be absent in all the conditions mentioned, but, when present, both acute obstruction and pancreatic hemorrhage may usually be eliminated. The diagnosis can generally be made only after exploration or post-mortem examination. (Plates III. and IV.)

Fitz[3] collected 22 cases of suppurative pancreatitis, the majority of which occurred in adults under forty. In this disease multiple abscesses may be scattered through the pancreas, or the gland may degenerate into a sac of pus which may burst into the duodenum or the peritoneal cavity. Only cases of acute suppuration resulting in abscess or in gangrene offer any hope from surgical interference. The first symptom of acute suppurative pancreatitis is severe gastric or abdominal pain, followed by vomiting and great prostration. The attack may begin with diarrhœa, though the bowels are usually constipated. Fever is generally slight. Chills, if present, begin about the third day. Later the abdomen becomes moderately swollen and tympanitic. Hiccough is a frequent symptom. If, in addition to the above symptoms, a tumor is found in the epigastrium, the diagnosis is strongly confirmed. Death may occur at the end of the first week. The usual course, however, is that of progressive emaciation and exhaustion, death taking place at the end of three or four weeks. In the cases collected by Fitz up to 1889 a tumor was found in but one. Out of 3 cases, Elliot[4] recognized a tumor in 2. He collected 10 in which a tumor was present. In 3 of these 10 cases the swelling was epigastric; in 3 it extended from the epigastrium along the border of the ribs to the left side; in 3 it was in the left upper abdomen below the ribs; and in 1 it was on the right side below the liver. The tumor was observed in from three and a half days to one month after the initial symptom. Koerte[5] reports 3 cases in which a tumor was found. Inflammations of the pancreas are probably of septic origin. Trauma and calculi are predisposing agencies. It has been suggested that intestinal worms may give rise to the disease. Abscess may come by extension from other structures or it may result from the infection of a cyst. A case of cystic infection is reported by the writer in the *Boston Medical and Surgical Journal* for May, 1892. A large pancreatic cyst had been successfully treated by incision and drainage. Reaccumulation of the fluid, some years later, caused, by pressure on the duodenum, the symptoms of acute obstruction. At the

[1] "Middleton-Goldsmith Lectures," *New York Med. Record*, vol. i., 1889.
[2] *Centralblatt für Chir.*, 1894, p. 1215.
[3] *Loc. cit.*
[4] *Boston Med. and Surg. Journ.*, April 11, 1895.
[5] *Archiv für klin. Chir.*, 1894, Heft 4.

autopsy the contents of the cyst were found infected by direct communication with the stomach.

Pus may arise from a peripancreatitis, a parapancreatitis, or from multiple abscesses in the gland itself. The inflammatory process may begin at any time and in any portion of the pancreas. In the early stages the pus is generally retroperitoneal, and often remains so. It may break into the peritoneal cavity or it may burrow extensively behind the peritoneum.

The **symptoms** in nearly every case point at first to the stomach or to the liver. Fever is not constant. Jaundice may result from pressure on the common duct. The urine may contain sugar, as in a case referred to by Senn. Ascites and œdema have been observed in some cases. To determine the situation of the tumor with reference to the stomach the latter may be inflated. Tympanitic resonance over the tumor, with or without distention of the stomach or transverse colon, points to a retroperitoneal cyst somewhere in the region of the pancreas.

The **diagnosis** is usually difficult: it depends upon the evidence of general sepsis, with localized pain and tenderness in the epigastrium, generally associated with a tumor in the region of the pancreas. Though the exact seat of the lesion cannot perhaps be definitely determined beforehand, the evidence is generally sufficient to warrant an exploration.

The **prognosis** in this form of pancreatic disease is distinctly bad. The patient may die from sepsis, from complications in neighboring viscera, from general peritonitis, or from exhaustion after extensive burrowing of pus in the retroperitoneal space. In the most acute cases death occurs in a few days. When the pus escapes into the intestinal tract a spontaneous cure may result. One case of this has been reported. Rupture into the peritoneal cavity results in a general inflammation and death. The presence of large veins in close relation with the pancreas causes at times fatal complications. The prognosis will doubtless prove more favorable with increased knowledge and experience in the surgical treatment of this affection.

The **treatment** of abscess of the pancreas on theoretical grounds does not differ from that of other abscesses in intimate relation with the abdominal cavity. If the products of inflammation could be drained as easily in the pancreatic region as in some others, surgical interference would offer excellent prospects of relief. Anatomically, incision and drainage in this region are not very difficult. Abscesses of the pancreas have thus far resulted unfavorably because the condition has not been promptly recognized and surgical treatment has been too late. Senn was the first to suggest operation in this condition. Successful cases have occurred in the hands of Koerte and Walsh.[1] Elliot reports a fatal case, and refers to Koerte's as the only successful one.

The indications for operation in inflammation of the pancreas are limited by the signs of pus-collection. Interference in the acute stage is opposed by Fitz, Koerte, Senn, and others. Operative measures thus far have been limited to the incision and drainage of abscess-cavities.

The surgeon's chief care in operations upon abscesses of the pancreas has been to prevent contamination of the general peritoneal cavity. If

[1] *Med. News*, Dec. 30, 1893.

the structures in front of the tumor are not adherent to each other and to the abdominal wall, incision may result in extensive peritoneal infection. The cut should be made in the median line, between the umbilicus and the ensiform cartilage, over the most prominent portion of the tumor, or, if no distinct mass is present, over the seat of the predominating symptoms. The stomach and transverse colon may overlie the abscess, and great care must be taken to avoid these structures. The layers of the omentum must be incised or torn to reach the pancreatic space. To be sure of the diagnosis it is well to explore the tumor with a small trocar before free incision. Before the tumor is either separated or incised the surrounding viscera must be carefully protected on all sides by means of gauze. The tumor may now be explored by free incision. It is better, however, to remove through an aspirating needle the greater portion of the contents of the abscess. The tumor is thus collapsed, subsequent manipulations facilitated, and the danger of contaminating the surrounding viscera lessened. After free incision the abscess-cavity should be thoroughly irrigated and drained. The tubes may be changed in two or three days and the gauze removed. Drainage will be necessary as long as discharge continues. Closure of the wound after too early removal of the tube may result in the reaccumulation of pus.

Pus starting from the pancreas and burrowing retroperitoneally may make its appearance as a fluctuating tumor in the flank. In such cases drainage should be established by incision from behind.

GANGRENE OF THE PANCREAS is one of the results of acute pancreatitis. Spontaneous cures of this condition have been reported in which the viscus has sloughed into the intestines and been discharged. Senn refers to 6 cases of gangrene; Fitz has collected 15.

Inflammations of the pancreas resulting in gangrene pursue a fulminating course. Surgical interference, therefore, to be of use, must be very early. Theoretically, there is no reason that a gangrenous pancreas should not be drained, or, by free incision and exploration, the dead structures removed. In this disease it is essential to make an early diagnosis, for interference to be of avail must be in the earliest hours of the disease.

CHRONIC PANCREATITIS or SCLEROSIS consists in an increase of the connective tissue, which may affect the whole organ, though it is generally limited to the head of the gland. In the early stages the pancreas is enlarged and vascular; later it is atrophied and contracted. This form of inflammation of the pancreas, like carcinoma of the head of the gland, is of surgical interest, because of the obstruction to the biliary flow through pressure upon the common duct.

The **etiology** of chronic pancreatitis is obscure. It is frequently associated with diabetes. It may be caused by antecedent inflammations in adjacent structures or by pancreatic calculi. Persistent jaundice, with emaciation and with absence of pain, suggests obstruction to the biliary flow through the head of the pancreas. This may be due to the condition under consideration or to the presence of an impacted stone or to the contraction of the foramen of exit into the duodenum.

The indications for **operative treatment** are those of stricture of the common duct with retention of pancreatic fluid or of bile. Retention of pancreatic fluid may result in the formation of a cyst from dilatation

of the canal of Wirsung. Obstruction to the biliary flow results in dilatation of the bile-ducts or of the gall-bladder, with cholæmia and general enlargement of the liver. The only permanent relief from this form of biliary obstruction is by cholecystenterostomy, as first suggested by Senn. Réelus of Paris[1] advocates for this condition and for cancer of the pancreas cholecystenterostomy whenever it can be done.

HEMORRHAGE OF THE PANCREAS.—In this disease death may take place suddenly from extensive hemorrhage into the gland and into the surrounding spaces. The disease is not, therefore, to be confounded with hemorrhagic pancreatitis. Five cases of this accident have been reported by Draper.[2] Hemorrhagic cyst may result from this lesion.

PANCREATIC CALCULI consist of phosphate or carbonate of lime, and are usually small, multiple, and white. They are found in the canal of Wirsung or some of its branches. In rare instances a single large stone has been found, as in Shipman's case, in which the weight of the stone was two hundred grammes. Rarely, irregular racemose calculi have been found. Pancreatic calculi have no surgical interest except in connection with cysts and with chronic pancreatitis. The presence of a stone can only be suspected as a cause of obstruction to the pancreatic and biliary flow or as a possible cause of acute pancreatitis.

CYSTS OF THE PANCREAS result (1) from obstruction by calculi, with attendant changes in the gland-parenchyma; (2) from obstruction by cicatricial contraction of the duct; (3) from obstruction by displacement of the pancreas; and (4) from trauma.

The cause of pancreatic cysts cannot always be made out even after exploration. A calculus, in rare instances, may be found and removed. In most cases, however, the exploration gives no clue to the cause. The fact that cysts of the pancreas disappear after incision and drainage throws some doubt upon the statement that cysts are always caused by obstructions; for if this were true a permanent pancreatic fistula would result in those cases in which the cause is not removed. The wall of the cyst may be thick when the obstruction has existed for a long time, or it may be thin in cysts which develop rapidly. Senn maintains that dilatations do not take place until the gland is atrophied. In rare cases the cyst-wall may become cartilaginous or ossified. Cysts of the pancreas vary in size and shape; they are usually globular and may attain the size of a man's head. Though generally round, these cysts may be racemose. An accessory pancreas may be the starting-point of the cyst. Whatever the situation of the obstruction, the cyst soon fills more or less space in front of the pancreas.

Though cysts of the pancreas are comparatively rare, Senn has reported 18 cases. Since 1893 reports of 12 operative cases have been published, besides 3 cysts of the abdomen in which the diagnosis between cysts of the peritoneum and cysts of the pancreas was doubtful. Of these 12 cases, 1 was by the writer.[3] Three other cases operated upon by myself since 1892 make the number of true cysts of the pancreas 14, besides 4 in which pancreatic origin was questionable. Out of the 14 cases, 12 recovered. Enucleation was performed in 2 cases; all the others were drained. In the case of my own, of questionable origin,[4]

[1] *Semaine méd.*, 1893, vol. xiii. p. 569.
[2] *Trans. Assoc. Amer. Phys.*, vol. i.
[3] *Boston Med. and Surg. Journ.*, March 21, 1895.
[4] *Trans. Amer. Surg. Assoc.*, 1882.

a cyst occupying the exact region of the pancreas was removed from a child of nine months, the cyst weighing nine pounds. Thin pancreatic tissue covered the surface of the cyst. Recovery followed, and the child has been well ever since. Whether the tumor originated in the pancreas or whether it was congenital or of retroperitoneal origin could never be made out.

Two cases of enucleation have recently been reported, 1 by Starkey and Clutton [1] and 1 by Zweifel.[2] Zweifel found in all the literature 31 cases treated by incision and drainage and 12 by extirpation. Of the former, 2 died; a fistula existed in 19, resulting fatally in 5. Of the 12 cases of extirpation, 1 died from hemorrhage (case of Veit-Ludolph), though the hemorrhage in Zweifel's case was very alarming. In 3 of the genuine cases collected since 1893 the origin was traumatic. Diabetes was noted in only 3 cases; in 1 it persisted;[3] in Zweifel's case it finally disappeared. Weir [4] reports a case of pancreatic cyst caused by a calculus and cured by abdominal massage, by which the stone was dislodged. Durante [5] reports a case caused by impaction of an intestinal round-worm in the duct. The operation was successful.

The **symptoms** of pancreatic cyst are chiefly local. Indefinite pain or discomfort may call attention to the epigastrium even before a swelling is perceptible. Pancreatic calculi, with the resulting cyst, may cause no subjective symptoms. Intestinal digestion may be somewhat interfered with if the pancreatic fluid is entirely shut off from the duodenum. In some cases the presence of sugar in the urine tends to confirm the pancreatic origin of an epigastric cyst. The tumor itself is characteristic. It fills more or less the space occupied by the pancreas. Pushing forward the stomach, omentum, and transverse colon, it causes a round, symmetrical swelling in the epigastrium. In such cases the stomach is above the cyst; at times the cyst appears above the lesser curvature and presses the stomach downward. The tumor is often so tense as to seem solid. In one of my cases the diagnosis of malignant growth was made before incision. In all the cases that have come under my observation the fluid has been confined under great pressure. Firmness and tension are more characteristic of a cyst connected with the pancreas than of any other fluid collection in this region. Extravasation filling the lesser omental cavity and sanguineous cysts do not possess the characteristic feature of tension seen in cysts of the pancreas in which the fluid is firmly grasped by the hypertrophied fibrous walls of the dilated canal.

Diagnosis.—To determine the nature of the tumor aspiration may be employed. This procedure, however, is not without danger, for the needle may perforate the stomach or the transverse colon before entering the cyst. The contents of the latter are under such pressure that extravasation will follow the use of even the smallest trocar. Dilatation of the stomach by means of air will often show the retroperitoneal situation of the tumor.

Sanguineous cysts of the peritoneum are often confused with pancreatic cysts. Brown [6] reports a case of abdominal trauma in which the

[1] *St. Thomas's Hospital Reports*, vol. xxi. p. 271, 1893.
[2] *Centralblatt für Gynäkologie*, 1894, p. 641.
[3] McBurney, *Annals of Surgery*, 1894, p. 492.
[4] *Med. Record*, Dec. 23, 1893.
[5] *Centralblatt für Chir.*, 1894, p. 424.
[6] *Lancet*, Jan. 6, 1894. p. 21.

cyst-fluid, at first non-pancreatic, later became pancreatic. Lloyd calls attention to this also, and Fitz refers to it.

Treatment.—The most important consideration connected with the treatment of pancreatic cysts is the decision between total extirpation and drainage. The removal of the entire cyst, if it were possible, would be the ideal operation for the relief of this condition. In most instances, however, the cyst, being practically nothing but the thickened walls of a dilated pancreatic duct intimately connected with and adherent to all adjacent structures, cannot be removed without subjecting the patient to unjustifiable risks. The technical difficulties in the way of total extirpation makes this procedure, in most cases, out of the question. In a cyst projecting through and from the body of the pancreas, connected with it by a comparatively small pedicle, total extirpation may be successful. The feasibility of this procedure can be demonstrated at the time of the operation. Whenever enucleation seems practicable, it should be attempted. If the difficulties are too great, the operation may be abandoned at any stage and drainage substituted. The chief danger of enucleation is in hemorrhage from the accidental wounding of surrounding vessels and in the shock attendant upon so difficult and prolonged an operation. Senn[1] says that total extirpation invariably results in death. The cases of total extirpation given above show that the operation can occasionally be done with success. Zweifel's operation is said to have been complete. In the case of the child alluded to above enucleation was very easy. This case, however, from the uncertainty of its origin, does not add materially to the evidence in favor of enucleation. The alternative, incision and drainage, can be relied upon in all cases in which extirpation is not practicable. The great objection to drainage is the persistence of the pancreatic fistula and the malnutrition which results from want of pancreatic fluid.

The operation for drainage of pancreatic cysts presents no great difficulties. Care must be taken not to wound the stomach or intestine in exposing the cyst. A median incision should be made between the umbilicus and the ensiform cartilage long enough to expose the tumor. The intestine or stomach, or both, will be found pressed between the abdominal wall and the cyst. By separating the omentum with the fingers or with a blunt instrument the cyst comes into view, usually adherent to the under surface of the omentum. Though the pancreatic fluid is usually aseptic, it is not invariably so; hence great care must be taken not to infect the exposed peritoneum. The cyst, having been collapsed by aspiration until its walls are lax, may be emptied and drained, care being taken to protect with gauze surrounding parts. The incision into the cyst should be large enough to permit thorough exploration with the finger for the detection of a stone. Drainage-tubes must be used in these cases until the discharge has practically ceased. This may require weeks, months, or years. If the dilatation is dependent upon an obstruction not removed at the time of operation, the fistula will probably persist indefinitely. In the 3 cases of pancreatic cyst of my own treated by incision and drainage, 2 recovered entirely, and the third, operated upon in March, 1895, had practically closed two months afterward. In one of the cases in which complete recovery took place, and in which the

[1] *Loc. cit.*

man regained his usual robust health, the cyst reappeared after some years, and caused death by a perforation into the stomach.

TUMORS OF THE PANCREAS.—The most common tumor of the pancreas is carcinoma, which may be primary or secondary. It is usually of the scirrhous form and situated in the head of the gland. Segre in 11,492 autopsies found only 132 tumors of the pancreas, of which 127 were cancer. Of these 127, 12 were limited to the gland itself. Cancer may start in the head of the pancreas as a primary disease, or it may extend from the stomach or from the intestines. Very few cases of primary sarcoma of the pancreas have been reported.

The surgeon's attention is called to tumors of the pancreas chiefly in cases of persistent jaundice. Tumors limited to the pancreas are rarely discovered or suspected except through those symptoms dependent upon obstruction to the flow of bile or of pancreatic juice. Persistent cholæmia is so conspicuous a symptom that in the absence of other causes attention is called at once to the pancreas.

The **symptoms** of malignant disease of the pancreas are variable. One of the most important, though not a constant sign, is fatty diarrhœa. Clay-colored stools with undigested food may be present. Interference with pancreatic digestion may result in diabetes. Pain may or may not be present. The general symptoms are those of progressive cachexia. Epigastric pain, with progressive cachexia, emaciation, jaundice, and fatty diarrhœa, should suggest strongly the possibility of malignant disease of the head of the organ. The gall-bladder is often dilated if jaundice is present. If a deep-seated, immovable tumor in the region of the pancreas can be felt, the diagnosis is confirmed. In establishing the diagnosis cancer of the pylorus, cancer of the liver, cancer of the intestines, cancer of the gall-bladder, and impacted gall-stones must all be eliminated. All these diseases have strongly characteristic symptoms, and can usually be diagnosed unless they are associated with cancer of the pancreas. The most important differentiation is between a gall-stone impacted in the common duct and cancer of the head of the pancreas. However clear the theoretical distinction between these conditions, it is often impossible to make a differential diagnosis at the bedside. The presence of a deep-seated, immovable epigastric tumor adds materially to the strength of the diagnosis. Such a tumor can rarely be made out. DaCosta could recognize it in only 13 cases out of 137.

It is doubtful whether radical excision of malignant disease of the pancreas is ever justifiable, not only because of the great technical difficulties, but because the chance of permanent cure is so slight. The operation should be attempted only when the disease is limited to the tail of the gland. The operation has been performed twice by Billroth.

Palliation in cancer of the pancreas is limited to the treatment of jaundice. The persistent and hopeless cholæmias seen in cancer of the head of the pancreas add so greatly to the sufferings of the patient, and shorten his life so materially, that interference is not only justifiable, but it is demanded. The only operation to be thought of is cholecystenterostomy, the anastomosis being made, if possible, between the gall-bladder and the duodenum. This operation will be facilitated by the great dilatation of the gall-bladder.

Surgery of the Spleen.

Anomalies and malformations of the spleen present nothing of surgical interest. The weight varies in different individuals, or even in the same individual, more than that of any other organ in the body. Small roundish bodies varying in number from one to twenty, similar in structure to that of the spleen, are occasionally found in the great omentum or the gastro-splenic omentum (Quain).

Wounds of the Spleen.—Stab and gunshot wounds, especially when received in the left side or in the back, may involve the spleen, though this organ on account of its smaller size is much less likely to be involved than the liver. When the spleen is wounded neighboring structures are usually injured—the stomach, the liver, the diaphragm, or the thorax. Numerous instances have been recorded in which the spleen protruded through wounds in the abdominal wall; most of the cases in which the spleen has been removed for traumatic causes have been of this nature. Twelve successful cases are given by Otis [1] and several are cited by Morris.[2] Slight penetrating wounds of the spleen, uncomplicated by injuries to other organs, have usually recovered. Larrey quoted by Morris [3] reports 3 recoveries from stab wounds of the spleen; Sappey,[4] 1 in a boy of eleven; Otis,[5] several. Recovery may take place from penetrating gunshot wounds of the spleen even when the bullet remains imbedded in the organ, as in cases reported from Guy's Hospital by Morris.[6]

The diagnosis depends upon the situation and the direction of the wound and upon the signs of internal hemorrhage. The spleen being unusually vascular, hemorrhage is the chief danger in wounds of this organ, as well as in operations upon it. If the hemorrhage is slight, the diagnosis cannot be made except by exploration; if excessive, the chances strongly favor serious injury to the spleen. Death in traumatic cases usually results from the loss of blood or from serious complications in other organs. Wounds may result in peritonitis, abscess, and septicæmia.

Treatment.—When, from the situation and direction of the wound, the spleen is thought to have been injured, surgical interference is not indicated unless there are signs of internal hemorrhage. The patient should be kept quiet, the wound scrubbed with antiseptics and covered with an aseptic dressing. If the constitutional symptoms are slight, explorations for the purpose of removing a bullet or for determining the depth and extent of a stab are not demanded. Clean wounds, unaccompanied by hemorrhage, are so unlikely to cause sepsis that active interference is not indicated until symptoms of the latter appear. When the signs of abscess are present, exploration is indicated and the principles of abscess-drainage should be applied. Peritonitis from this cause should be treated on general principles. If severe symptoms follow immediately or soon after the receipt of the wound, free exploration is demanded to ascertain the exact extent and nature of the lesion. Hemorrhage, if excessive, may require ligation of the splenic artery and removal of the

[1] *Med. and Surg. Hist. of War of the Rebellion*, II. vol. ii. p. 152.
[2] *Ashhurst's Encycl.*, vol. v. p. 1102.
[3] *Loc. cit.*
[4] *L'Union médicale*, N. S., t. xxi. pp. 408, 1864.
[5] *Loc. cit.*
[6] *Loc. cit.*

gland. Oozing may be treated by gauze packing. When the spleen, injured in the course of other operations, bleeds excessively, the same principles of treatment apply. The friability of the organ renders it particularly liable to tears during the separation of tumors, especially of the kidney or pancreas. Gauze tamponage is usually sufficient to control hemorrhage from this source. When the spleen has been wrenched from its position and protrudes through a large wound, the question of splenectomy may arise. The structure of the organ prevents suture in position, because the stitches tear out. Under such circumstances the spleen should be held in position by means of gauze packed in the wound and by the pressure of an external pad. In the event of failure by this method it may become necessary to extirpate the organ.

RUPTURE OF THE SPLEEN is an accident peculiarly liable to occur on account of its unusual friability. It may be traumatic or it may be spontaneous. Traumatic rupture of a healthy spleen may be the result of violent blows upon the abdomen or upon the lower thoracic wall on the left side. It is usually associated with injuries to other solid viscera. The commonest accompanying injury is fracture of the ribs overlying the spleen. Parenchymatous softening of the spleen or fixation by old and strong adhesions increases the liability to traumatic rupture. Vigla and Collin[1] have reported cases of disease in which comparatively slight violence or even muscular exertion has caused this lesion. The diagnosis of rupture, as of penetrating wounds, depends upon the history, the nature, and the location of the blow, with the signs of hemorrhage.

Treatment.—Hemorrhage is the principal danger in ruptures as well as in stab and gunshot wounds of the spleen, and therefore requires the same principles of treatment. Slight symptoms should be treated by rest in bed, ice-bags, and sedatives. When hemorrhage is extensive and the ordinary measures for its control fail, to save life total extirpation may become necessary.

Ashhurst[2] refers to 21 successful cases of splenectomy for traumatic conditions. Nussbaum reports 26 cases with 16 recoveries. Lane[3] in 2 cases attempted splenectomy for rupture; both died from shock five hours after the operation. Riegner[4] reports a successful case; Trendelenburg, cited by Vulpius,[5] a fatal one. Vulpius maintains that this operation should be attempted oftener.

SPONTANEOUS RUPTURE OF THE SPLEEN occurs in some infectious diseases, such as typhoid fever and cholera. It has also occurred in chronic malaria; Osler[6] refers to three cases of this kind. Rupture, even in these conditions can hardly be called spontaneous, for it usually is the result of some slight violence.

SUPPURATIVE SPLENITIS; PERISPLENITIS; ABSCESS AND GANGRENE OF THE SPLEEN.—It is questionable whether inflammation of the spleen is ever idiopathic. It usually occurs through metastatic infarction from septic emboli. Occasionally the inflammation is the result of direct infections of traumatic origin. In rare instances inflammations may extend to the spleen from the stomach or from other contiguous organs.

[1] *Arch. gén. de Méd.*, 1843 and 1844.
[2] *Encyclopedia*, vol. v. p. 1103.
[3] *Lancet*, 1892, p. 692.
[4] *Berlin. klin. Woch.*, 1893, No. 8.
[5] *Beitrage zur klin. Chir.*, vol. xi. p. 667, 1894.
[6] *Text-book of Med.*

In pyæmia and allied septic conditions the spleen is frequently the seat of hemorrhagic infarctions by which small single or multiple abscesses may be formed. By the coalescence of a number of such a single sac may result sufficiently large to involve the whole organ. Parenchymatous inflammations of the spleen, which start from metastatic emboli or from other septic causes, involve sooner or later its peritoneal covering. The resulting perisplenitis forms adhesions through which pus may safely escape into the stomach or into the intestine or through the skin. In the absence of adhesive barriers the abscess may break directly into the abdominal cavity.

The so-called primary suppurative splenitis occasionally met with in the course of great systemic depression is caused by septic infection in an organ the vitality of which has been affected by constitutional diseases like malaria or typhoid. The occurrence of this lesion is favored by the coexistent vascular engorgement of the spleen.

The existence of primary perisplenitis, with so-called perisplenic phlegmon, not originating in the parenchyma and not extending from neighboring parts, is very doubtful.

Diffuse abscesses of the spleen are uncommon. Inflammations of the organ rarely become suppurative. The abscess when present is usually circumscribed (Ziegler,[1] Ponfick,[2] and Mosler.)[3]

The **diagnosis** of splenic abscess is generally hard to make. Ill-defined pain and tenderness in the region of the spleen should suggest the possibility of a splenitis, especially if the organ is enlarged. Pain is generally absent unless the capsule is involved; when present, it may radiate into the left arm or shoulder. Tenderness on deep pressure, with fluctuation, confirms the diagnosis. Evidence of constitutional sepsis, as shown by fever, remittent or intermittent, is of little value in establishing a diagnosis, because this symptom may be due to the original source of infection. The rupture of splenic abscess into the intestinal canal is attended by the vomiting of pus or blood or its passage in the stools. Such an occurrence is, however, rare. Pleurisy may be present by extension through the diaphragm.

Treatment.—The exact seat of the lesion cannot, unfortunately, often be made out with sufficient certainty to justify an exploration; hence the prognosis is grave. The disease, uninfluenced by surgical interference, goes on to serious complications or to a fatal termination before its nature is more than suspected. Localized collections of pus in the spleen, like similar conditions in the liver, theoretically admit of drainage and of recovery. The incision should be made over the most prominent portion of the tumor: if below the margin of the ribs, through the abdominal wall; if behind the ribs, through an intercostal space. A tumor non-adherent to the abdominal parietes should be approached through the peritoneal cavity by an incision directly over the mass. When the incision is carried through an intercostal space, the greatest care must be taken not to infect the pleural cavity. The dissection should be carefully made until the tumor and its attachments are demonstrated. If adhesions have not shut off the abdominal or the pleural cavity, gauze barriers should be used to prevent infection. The abscess

[1] *Text-book Patholog. Anat.*
[2] *Virchow's Archiv*, vol. lx.
[3] *Ziemssen's Encyclopedia*, vol. viii.

should then be opened, drained, and irrigated like abscess of any other organ.

Aspiration of a splenic tumor is not without danger. When there is good reason to suspect the presence of a collection of pus intelligent exploration, with free dissection and thorough drainage, is preferable.

The question of extirpating the spleen arises when a general septic condition of the organ, with numerous small abscesses, is present. Lesions of this kind cannot be treated successfully by incision and drainage. The more rational procedure, though perhaps a desperate one, is extirpation of the whole organ. (See Operations on the Spleen.)

GANGRENE OF THE SPLEEN.—The softened and congested spleen of acute disease sometimes, as the result of intense septic inflammation, becomes gangrenous. This lesion is so rapid and so fatal that it gives no time for the consideration of surgical interference. Theoretically, splenectomy, if practised early enough, might result in cure.

DISPLACEMENTS OF THE SPLEEN.—The spleen is held in its normal position by folds of the peritoneum which attach it to the stomach and to the diaphragm. When these ligaments are lengthened or stretched a change in the normal position of the spleen, sometimes to an excessive degree, results. Slight changes of position may be due to left-sided pleural effusions, which depress the diaphragm and with it the spleen. On the other hand, in great intestinal distention the spleen may be pushed up against the diaphragm. As already stated, the position of the spleen may be changed by traumatism, it may be prolapsed in an abdominal wound, or it may be violently separated from its attachments. Extreme changes of position, aside from traumatic prolapse or dislocation, are due to excessive stretching of the splenic ligaments, by which the organ may be dislocated as far as the pelvis or into the right flank. Extreme elongation of its ligaments may give the spleen a cord-like pedicle. In such cases rotation about its attachments may result in gangrene. The spleen itself is generally enlarged coincidently with the elongation of its ligaments; indeed, the stretching is usually due to the increased weight. Congenital elongation of the splenic ligament is very rare. The diseases attended by hypertrophy which most commonly cause wandering spleen are so-called simple idiopathic hypertrophy and chronic malaria. Cases do occur, however, in which no disease nor enlargement of the spleen can be detected. According to Mosler, Diett, and the majority of writers, the disease occurs almost always in women.

The **symptoms** of wandering spleen are caused by the increased weight of the organ dragging upon the stomach and pancreas. The circulation of these organs, and of the spleen itself, may be impaired by the narrowing of the vessels from pressure. When adhesions have formed between the spleen and other organs, additional symptoms may take place from dragging. The circulation of the stomach has been so impeded in this manner that gangrene and death have resulted.

The chief symptom of wandering spleen is a constant dragging pain.

The **diagnosis** is established by the presence in the abdomen of a movable tumor which radiates about the usual position of the spleen. The tumor usually greatly exceeds in size that of the normal spleen, and

can be recognized by the presence of the hilum; moreover, the usual splenic dulness is absent.

Treatment.—When the mobility of the spleen is slight, palliative measures may be used. The patient should be placed in dorsal decubitus, and the spleen held in position by means of large elastic compresses and tight swathes. In the mean time the medical treatment may be directed to the disease causing hypertrophy.

Total extirpation of the spleen is the only radical cure. Splenectomy for this cause has a very slight mortality. The operation has been performed 21 times, according to Vulpius,[1] with only 2 deaths, both of which were from peritonitis. Warnek[2] and Kramer[3] add 2 successful cases.

HYPERTROPHIES AND TUMORS OF THE SPLEEN.—Temporary enlargements of the spleen occurring in the course of acute infectious diseases are not of surgical importance. Hypertrophy of the spleen may be (1) simple or idiopathic, (2) malarial, (3) leukæmic and pseudo-leukæmic.

(1) Simple or idiopathic hypertrophy of the spleen occurs without changes in the blood or lymph-glands. Pathologically, it is a chronic hyperplasia. Owing to the obscurity of the etiology, hypertrophy of the spleen not due to leukæmia or pseudo-leukæmia, to chronic disease, or malaria, is called idiopathic, and the diagnosis must be made by eliminating these diseases.

(2) Malarial enlargement is the most common of all chronic splenic hypertrophies.

(3) The enormous enlargement of the spleen seen in leukæmia and in pseudo-leukæmia is accompanied by the characteristic changes in the blood and the lymph-glands seen in these diseases.

Chronic enlargements of the spleen occurring in cirrhosis and other chronic diseases of the liver, in amyloid disease and in the passive congestions of cardiac and pulmonary disease, are surgically of no importance.

PRIMARY NEW-GROWTHS OF THE SPLEEN are very rare. Cancer, though it has been known to occur as a primary growth, is almost always secondary. Mosler cites three cases in which the disease originated in the spleen. The spleen has never been removed for this cause. The diagnosis of the primary growth is hardly possible. Sarcoma of the spleen is also very rare. Vulpius[4] cites four cases of splenectomy for this condition. No recorded cases of its primary occurrence have been found.

TUBERCULOSIS OF THE SPLEEN is not uncommon. It is always associated with advanced tubercular processes elsewhere; moreover, in nearly all cases of miliary tuberculosis the spleen is affected. Chronic tuberculosis of the spleen appears in the form of caseous nodules. But one case of splenectomy for tuberculosis has been recorded—that of Burke.[5] Extensive tubercular infiltration limited to the spleen would seem to demand extirpation of the organ. This lesion, however, is so rare and its presence so difficult to determine that the question of surgical interference is hardly likely to arise. Nevertheless, on December

[1] *Loc cit.* [2] *Centralblatt für Chir.*, 1894, p. 380. [3] *Ibid.*, p. 1046.
[4] *Loc. cit.* [5] *Dublin Journal*, vol. lxxxvii. p. 22.

2, 1895, during an abdominal exploration made by the writer for a tumor supposed to be pancreatic, the disease proved to be an enlarged spleen covered with miliary nodules. No other abdominal organs were affected. The chief symptoms, pain and jaundice, were found to be due to large impacted gall-stones. The spleen was not removed.

SYPHILIS OF THE SPLEEN may appear as a diffuse hyperplasia or in the form of gummata. The former, congenital or acquired, is the commonest variety; the latter is very infrequent. Diffuse hyperplasia is not infrequently seen in syphilitic children. The only surgical importance of syphilis of the spleen is the enlargement, which, with its resulting symptoms, may in rare instances justify splenectomy. But one case, however, has been found of extirpation of the spleen for this cause, that of Vulpius.[1]

CYSTS OF THE SPLEEN may be simple collections of serum or blood or they may be due to the echinococcus. Cysts containing blood or serous fluid, though occasionally observed, are more of anatomical than of surgical interest. No statistics as to their relative frequency can be found. Vulpius gives 4 cases of splenectomy for so-called simple cysts. Hahn[2] collected 4 cases of splenectomy for blood-cysts, all of which recovered.

Hydatid cysts of the spleen, though rare, are not so infrequent as usually stated. Neisser[3] in 805 cases of echinococcus cyst found 28 of the spleen—3.4 per cent. Trinkler[4] in 2117 cases found the spleen affected in 68—3.2 per cent. Mosler[5] in 1884 collected 15 cases, the majority of which were aspirated; 6 died, 6 recovered, and 3 were doubtful. Trinkler[6] found 6 deaths in pre-antiseptic days in 14 operations for hydatids of the spleen—a mortality of 42 per cent.; in recent years 23 cases with 5 deaths—a mortality of 21.7. Vulpius[7] and Ceci[8] found 5 cases of splenectomy for echinococcus cysts, with 2 deaths; Hahn 7 cases, including one of his own, with 5 recoveries. According to Hahn, splenectomy for cysts of the spleen has been performed 11 times, with a mortality of 18 per cent. Of these cases, 7 were hydatids and 4 were blood-cysts. Puncture, with or without aspiration, has been much more fatal, according to Trinkler—22 cases with 9 deaths, a mortality of 49 per cent.

Echinococcus cysts of the spleen generally require years for their development. The symptoms are pain in the back and in the left side, with signs of pressure on the stomach and on the intestines.

The **diagnosis** depends upon the physical attributes of the tumor. Hydatid cysts may easily be mistaken for cysts of the ovary or of the pancreas, for hydronephrosis, or for neoplasms. Neither fluctuation nor the hydatid bruit, especially mentioned by Bergmann, are infallible signs. Modern authorities, almost without exception, favor open incision and drainage for hydatid cysts rather than aspiration.

OPERATIONS ON THE SPLEEN: ASPIRATION; SPLENOTOMY; SPLENECTOMY.—*Aspiration of the Spleen.*—Aspiration of any intra-abdominal tumor is attended by grave dangers, prominent among which

[1] *Loc. cit.*
[2] *Deut. med. Woch.*, July 11, 1895.
[3] *Echinococcus Krankheit.*, Berlin, 1887.
[4] *Revue de Chir.*, 1894, p. 107.
[5] Monograph, *Ueber Milzechinococcus und seine Behandlung*, 1884.
[6] *Loc. cit.*
[7] *Loc. cit.*
[8] *Policlinico*, 1894, No. 17.

are those of hemorrhage and of sepsis. The latter objection is not likely to be met with except in cases of splenic abscess; the former is a grave one on account of the enormous vessels connected with the spleen. For this reason alone the use of the aspirator is to be condemned, especially in view of the great safety of explorations. Statistics show, too, that in cases treated entirely by aspiration—notably cysts—a fatal result is much more frequent than after splenectomy, the percentage of deaths in the former varying from 18 to 49. It is safe, therefore, to conclude that the aspirating needle should never be used, except, possibly, in certain cases of abscess or cyst adherent to the abdominal wall. After an exploratory laparotomy the dangers of contamination may be lessened by removing the fluid through an aspirator before free incision is made.

Splenotomy, or *laparo-splenotomy*, formerly meant extirpation of the spleen. At the present time its use is restricted to those cases in which an abscess or cyst is drained by open incision.

Incision into the spleen should be made below the border of the ribs over the most prominent portion of the tumor. If the tumor is dislocated, the incision must be made to correspond with its abnormal position. In rare cases the cut may be made through an intercostal space. It is seldom possible to tell beforehand whether the conditions will demand simple incision or total extirpation. In all cases, therefore, preparation should be made for a possible splenectomy. In septic cases without adhesions a preliminary walling off of the surrounding structures must be made before the cyst or abscess is opened. The fluid contents should be withdrawn through the aspirating needle before free incision is made. Adequate drainage of the cyst or abscess-cavity should be provided by means of tubes, of gauze, or of both.

Splenectomy.—The first successful removal of the spleen was probably done by Zaccaralla in 1549, although the authenticity of this case is doubted by many authorities. In 1826, Quittenbaum of Rostock removed a diseased spleen; the patient, a woman, died in six hours. In 1855, Kuechler of Darmstadt removed a spleen for malaria; the patient died of hemorrhage in two hours. The first operation in England, performed by Sir Spencer Wells in 1865, resulted fatally in six days. The first successful case was that of Pean in 1867. In 1888, Wright[1] of Manchester collected 62 cases of splenectomy. The fullest and most valuable statistics of this operation are those of Vulpius of Heidelberg,[2] who in 1893 collected 121 cases in which splenectomy had been performed for different causes. In the last two years a few additional cases have been recorded. The average number of cures after splenectomy for all causes has been about 50 per cent.

Splenectomy has been performed for (1) leukæmia, (2) malarial hypertrophy, (3) simple hypertrophy and wandering spleen, (4) cysts, (5) malignant disease, (6) abscess and inflammatory changes, (7) syphilis and amyloid degeneration, (8) wounds and ruptures.

(1) *Splenectomy for Leukæmia.*—28 cases of splenectomy for this cause have been reported; 25 died from the immediate effects of the operation; of these, 20 died from hemorrhage in the first twelve hours. Only 1 case recovered, that of Franzolini.[3] The 2 other cases that sur-

[1] *Med. Chron.*, Dec., 1888. [2] *Loc. cit.* [3] *Wiener med. Woch.*, 1883, No. 20.

vived the operation lived—1 thirteen days, and 1 eight months; both died from the general progress of the disease. The diagnosis in Franzolini's case has been questioned because of the uniformly fatal results in other cases. From these statistics it must be concluded that it is unjustifiable to remove the spleen in leukæmia, save in those exceptional cases in which the blood-changes are slight and the tumor large. Even then the wisdom of interference may be questioned. If it is possible to prevent death from hemorrhage, the progress of the disease will not be arrested, for leukæmia is a systemic disease which will still exist even after removal of the spleen.

Vulpius gives statistics of 26 cases of splenectomy in which malaria was the cause of the hypertrophy. Of these, 11 died, a mortality of 42.2 per cent. Subbotic[1] reports 3 additional cases, with 2 recoveries and 1 death—making a total of 29 cases, with 12 deaths.

Of the 43 recorded cases of splenectomy for simple hypertrophy and wandering spleen, 40 are collected by Vulpius. In 21 of his cases there was an idiopathic hypertrophy; in 19 the operation was performed for dislocation. Orecchia has reported a case of splenectomy for idiopathic hypertrophy, with recovery; Warnek,[2] a successful case for a much-inflamed wandering spleen. A similar case was reported by Kramer. In the 43 cases of operation for simple hypertrophy or wandering spleen the mortality is 20 per cent. According to Vulpius, the mortality in malarial hypertrophy is about 10 per cent. higher. All the cases which resulted fatally after operation were those in which the tumor was very large. The limit of safety would seem to be a tumor of about 3000 grammes. Death resulted from shock in 3 cases; from exhaustion and sepsis in 1 case each; from hemorrhage in 7 cases. Of the 21 cases of splenectomy for wandering spleen, only 2 resulted fatally. In malarial tumors there seems to be no relation between the size of the tumor and the mortality.

Splenectomy for cysts, according to Hahn, has been done 11 times—7 times for hydatid cysts and 4 times for simple cysts—with a general mortality of only 18 per cent. Subbotic[3] adds a successful case of operation for large blood-cyst in a malarial woman.

The only cases of splenectomy for malignant disease that we have been able to find are 4 cases of sarcoma: in 1 death resulted from the operation; in the other 3 the patients succumbed later to the primary disease.

Three cases of splenectomy for abscess are recorded, all of which recovered; and 3 cases of attempted splenectomy for chronic congestion, all of which died (Vulpius). The only attempt to remove an amyloid spleen was a failure. One case of splenectomy for syphilitic hypertrophy was successful. (For statistics of splenectomy for wounds and ruptures, see p. 371.)

Burke[4] has removed the spleen for tuberculosis; Conklin[5] for hypertrophy with twisted pedicle.

The effect of splenectomy on the blood- and lymph-systems is a subject of extreme interest and importance in connection with the surgery of the spleen. Twenty-nine cases have been reported in which careful

[1] *Wien. med. Woch.*, 1894, No. 36. [2] *Centralblatt fur Chir.*, 1894, p. 380.
[3] *Loc. cit.* [4] *Dublin Journal*, vol. lxxxvii. p. 540. [5] *Med. Rec.*, 1894.

investigation of the blood was made after the operation, but in only 19 of them was the examination made before. Extirpation of the spleen in cases of leukæmia results probably in a still further diminution of the red cells. In Franzolini's doubtful case there was a return to normal condition. So far as can be ascertained, removal of the spleen seems to cause a transient decrease in the number of red corpuscles and an increase in the number of white, the ratio gradually becoming normal. Changes in the lymphatic system are not constant. In a few cases multiple enlargement of the lymphatics has been observed. In only three cases was a hyperplasia of the thyroid developed: Vulpius hence concludes that the possibility need not be considered in connection with the operation.

If we omit those splenectomies performed for chronic congestion, for amyloid disease, and for leukæmia, 85 cases remain, of which 29 died. Of the 6 cases collected by the author since 1893, only 1 was fatal—all of these for simple or malarial hypertrophy or for cyst. Splenectomy, therefore, on statistical grounds is indicated in simple or malarial hypertrophy, in wandering spleen, in cases of cyst or of abscess, wounds, and ruptures, and, rarely, in cases of malignant growth.

The removal of a spleen situated not far from its normal position requires an incision along the borders of the ribs on the left side. In most forms of splenic hypertrophy the tumor can be felt below the borders of the ribs, and in some instances, notably in wandering spleen, it may be removed far from the costal border. The first incision should be long enough at least to admit the hand, in order that the situation of the tumor, its relations and adhesions, may be accurately ascertained. Forcible manipulations of the spleen are liable to be attended by laceration. Before delivery is attempted, therefore, and before ligation of the large vessels, the incision should be extended so that the manipulations can be intelligently performed, the chief object at this stage of the operation being the prevention of hemorrhage.

The connections of the spleen to the stomach and to the diaphragm must be carefully separated and tied. The ligatures may be applied in sections, or to the whole pedicle at once if it is a small one. If practicable, the splenic artery should be secured before separation and delivery of the tumor is attempted. It will be found necessary at times, however, to deliver the spleen before its attachments can be tied.

After removal of the spleen the abdominal wound should be closed, unless the presence of sepsis is suspected or unless there is abundant oozing. Under such circumstances gauze drainage for two or three days is necessary. When the hemorrhage is abundant, and can in no other way be controlled, the depths of the wound must be packed with sterile gauze. The subsequent management of such cases differs in no way from that after abdominal operations generally.

Splenopexis.—Recently Rydygier has advocated splenopexis, or the securing of the spleen in place by sutures, as the routine treatment in all cases of wandering spleen in which the hypertrophy is not so extreme as to contraindicate it. His case, reported before the Twenty-fourth Congress of Deutsch. Gesellschaft für Chirurgie in Berlin on the 20th of April, 1895, and published in the *Archiv für klin. Chir.*, 1895, vol. l. p. 880, is the first case of the kind. He brought the spleen into its normal

position, and tied it there in a pocket made by stitching the parietal peritoneum to the gastro-splenic omentum. In this case three months after the operation the spleen was still in place. Rydygier states that he has no doubt that in the future there will be no more reason to resort to splenectomy for wandering spleen than there is to-day to do nephrectomy for wandering kidney. Zykow[1] and Plücker[2] have also advocated this method of treatment. No opinion as to the value of the operation can be expressed until more cases are available.

Surgery of the Omentum.

Ruptures and Wounds.—Rupture of the omentum may take place from abdominal contusion, although it is not common. In some cases the tear of the omentum may be the only injury, as in the case reported by Barling. Fevrier, Adam,[3] and Michaux[4] have called attention to the fact that, though abdominal contusions but rarely cause tears in the omentum and mesentery, they may occasionally result in fatal hemorrhage. Gross[5] reported a fatal case. Slight rupture of the omentum alone, without involvement of some large vessel, is often overlooked. The dangers in omental tears come from hemorrhage, and later from septic changes, as in the case reported by Pitt[6] in which a small tear of the omentum resulted in localized necrosis, gangrene, and fatal septic peritonitis. According to the statistics of Fevrier and Adam,[7] out of 29 collected cases of internal injury from abdominal contusion, tear of the omentum was present in only 3.

The **diagnosis** of rupture of the omentum cannot be made without exploratory laparotomy.

The omentum may be involved by any penetrating wound of the abdomen. A portion of the omentum prolapsed into the abdominal wound should be either thoroughly cleansed and replaced or ligated and removed. Hemorrhage from a large omental vessel may be controlled in the usual way.

Abscess of the omentum, whatever its cause, is in reality a form of localized peritonitis. It may originate as a septic process in wounds or ruptures of the omentum; but the common omental abscess starts, by extension or perforation, from some abdominal organ—*e. g.* the intestines, liver, spleen, stomach, or vermiform appendix. The omentum, from its propensity for forming adhesions, is largely responsible for the confining of septic products to localized regions of the peritoneum. This is frequently seen in acute appendicitis. Though simple cysts of the omentum may suppurate, most of the reported cases have doubtless been dermoid cysts of the ovary intimately adherent to the omentum.

The **symptoms**, **diagnosis**, and **treatment** of omental abscess are those of localized peritonitis.

Cysts of the omentum may be serous cysts, blood-cysts, lymph-cysts, and hydatid cysts. The existence of dermoid cysts of the omentum is questionable. Cysts of the omentum have a close relationship to cysts

[1] *La Semaine méd.*, Oct. 16, 1895.
[2] *Centralblatt für Chir.*, 1895, No. 40.
[3] *Archives Prov. de Chir.*, March and April, 1895.
[4] *Bull. et Mém. Soc. de Chir.*, April, 1895.
[5] *System of Surgery*, vol. ii. p. 679.
[6] *Lancet*, 1889, April 20.
[7] *Loc. cit.*

of the peritoneum and of the mesentery. The origin of simple serous cysts is not certain. Many of them, as has been suggested by Rokitansky, may be due to inflammatory changes, the fluid being merely exudation. The etiology of the large lymph-cysts of the omentum is also disputed, and not much has been written on the subject. According to Schwarzenberger,[1] their origin may possibly be inflammatory; in most cases they are undoubtedly due to a diffuse dilatation of the lymph-spaces; appearing in young children, they are probably of congenital origin.

True lymph-cysts of the omentum are rare. Only one case—that of Schwarzenberger's, in which an accurate microscopic diagnosis of multilocular lymph-cyst was made—has been reported. This case was that of a girl four years old. The cyst was excised and the patient recovered.

A case of large simple cyst of the omentum, also in a child four years old, was operated upon by Spencer Wells.[2]

Segond[3] has reported an operation for a large cystic fibro-sarcoma. Operations for large omental cysts have also been reported by Doran.[4] According to this observer,[5] no dermoid cysts of the omentum ever occur. All the cases reported as such have been found, on examination, to be ovarian cysts incorporated in the layers of the omentum.

Hydatid cysts of the omentum, according to Schwarzenberger, are never primary. In most of the cases the starting-point has been the liver. In cases of general hydatid disease the omentum, mesentery, and peritoneum may become involved. Cases of hydatid cyst of the liver, pleuræ, omentum, mesentery, peritoneum, and bladder have recently been reported by Page.[6] Blood-cysts of the omentum are necessarily of traumatic origin.

Solid tumors of the omentum are fibromata, lipomata, carcinomata, and sarcomata. Fibroid tumors are very rare. Differentiation between them and other forms of peritoneal and retroperitoneal growths is difficult. Clarke[7] reported the attempted removal of an extremely large fibroid of the small omentum. Death ensued on the eighth day after operation. The usual form of intra-abdominal fatty tumors is retroperitoneal, either perirenal or intramesenteric. Both of these are very rare; lipoma of the omentum is rarer still. Meredith[8] reports the successful removal of an omental lipoma weighing fifteen and a half pounds in a woman of sixty-two. Foster[9] reports a case in which a lipoma weighing fifty-five pounds was discovered on the post-mortem table. Augagneur[10] gives account of 11 cases, all but 1 operated on for cysts. Edebohls[11] cites 3 cases in which such a growth was diagnosticated as fibroid of the uterus.

Cancer is thought never to be primary in the omentum, but cancer of the omentum, secondary to cancerous disease in the abdomen and elsewhere, is comparatively common. Turton[12] and West[13] have reported cases

[1] *Beitrage zur klin. Chir.*, vol. xi., 1894, p. 713.
[2] *Brit. Med. Journ.*, June 14, 1890.
[3] *Bull. et Mém. Soc. de Chir.*, 1893, vol. xix. p. 300.
[4] *Trans. Obstet. Soc.*, vol. xxiii. p. 164.
[5] *Med. Chir. Trans.*, vol. lxviii. p. 236.
[6] *Med. Rec.*, Sept. 21, 1895.
[7] *Trans. London Path. Soc.*, vol. xliii. p. 60.
[8] *Trans. Clin. Soc.*, 1887.
[9] *Trans. London Path. Soc.*, 1868.
[10] Cited by Schwarzenberger, *loc. cit.*
[11] *Amer. Journ. of Obstetrics*, vol. xxv. p. 23.
[12] *Brit. Med. Journ.*, May 17, 1890.
[13] *Ibid.*, Feb. 22.

of cancer primary in the omentum; but the evidence on which their conclusions were founded is not positive.

Sarcoma, on the other hand, although much rarer than cancer, may occasionally be primary in the omentum, as in a case of large myxosarcoma in a man twenty-seven years old reported by Tait,[1] and a similar case shown at a meeting of the London Pathological Society in 1886.

Tubercular involvement and enlargement of the omentum may be found associated with tubercular disease of the peritoneum, intestines and other viscera, or with acute general tuberculosis.

Symptoms and Diagnosis of Omental Tumors.—In general it may be said that tumors of the omentum have a singular lack of symptoms. Attention is called to them only when their size or position gives rise to pressure-symptoms. In the majority of cases a correct diagnosis before operation has not been made. The reason for this is probably the fact that omental tumors themselves are infrequent, and that they are usually so intimately adherent to other organs that the omentum itself as the site of the growth is not considered. According to Schwarzenberger,[2] a superficial tumor in the region of the umbilicus, with its long axis in the median line or obliquely a little to the left—one that can be pushed sidewise and upward, but not downward, that is evidently unconnected with the liver, spleen, kidney, and pelvic organs, unassociated with functional disturbances (as would not be the case in tumor of the stomach, intestine, or mesentery),—a tumor of this kind is probably a tumor of the omentum. Augagneur emphasizes the fact that the tumor does not move with respiration. Witzel states that the peristaltic action of the intestines communicates a corresponding wave-like motion to the tumor. When the tumor is small and movable, these diagnostic signs may theoretically be of value, but not after increase in size and weight has caused change in position and adhesions to other organs. These tumors may become adherent anywhere in the abdomen, and may simulate any form of intra-abdominal growth. Aspiration is the only trustworthy method of securing evidence as to the cystic nature of the tumor. Palpation, with or without anæsthesia, may render possible a differential diagnosis between tumors of the omentum and tumors of the abdominal wall. Tumors of the alimentary tract may be expected to cause severe functional disturbances. Tumors of the pancreas are in the main malignant, are very slightly movable, and generally cause jaundice. Encysted peritoneal exudations, especially in the umbilical region, simulate exactly tumors of the omentum. It is in many cases impossible to differentiate between omental and ovarian cysts. If there are no adhesions, it would seem as if vaginal and rectal examination, with or without ether, would settle this point; but with strong adhesions of an omental cyst to the pelvic organs these measures of diagnosis will often prove futile. Aspiration should be used only for diagnostic purposes and in those cases in which extirpation of the tumor or drainage through open incision is impossible. Tumors should be removed if possible. Cysts may be dissected out; when this is impossible they may be drained.

[1] *Lancet*, Jan. 23, 1886.

[2] *Loc. cit.*

Surgery of the Abdominal Wall.

Incisions may be made anywhere through the abdominal wall. The seat of the incision depends upon the lesion, and is considered in connection with each. When the indications point to no definite spot the cut should be made in the median line. A consideration of importance in the selection of the place of incision is the liability to ventral hernia. When the cut is across the muscular fibres the tendency to hernia is usually regarded as greater than when the incision is parallel to them. It is doubtful, however, whether ventral hernia occurs any more frequently in one part of the abdomen than in another—whether a primary union between muscular fibres is not fully as strong as one in the fibrous tissue of the median line. In some cases it is possible so to divide the abdominal wall that the muscular bundles are not cut, as in the method proposed by McBurney in removing the vermiform appendix. When for purposes of exploration it is possible to follow the section of McBurney, the dangers of hernia are enormously diminished.

To prevent the formation of ventral hernia various methods of suturing have been proposed. It is doubtful whether any one of the complicated methods possesses advantages over a single layer of interrupted sutures embracing the whole thickness of the abdominal wall. Some surgeons sew the wound layer by layer, a row of stitches being applied to the peritoneum, to the muscular wall, and to the skin. The chief disadvantage of this method is that it leaves blind spaces which, becoming filled with blood, are more liable to result in suppuration. A combination of the two methods consists in the application of interrupted stitches through the whole abdominal wall, and, previous to the application of these, a line of interrupted or continuous sutures to the muscular layer. While the muscular layers are being united the deep stitches are held on the stretch by an assistant, so as to prevent the possibility of pinching a coil of intestine. This method is very successful, possessing the advantages of both the additional support of a second layer and the obliteration of dead spaces. The needle used in abdominal suture should be the round needle or the glover's needle with dull edges. The danger from the use of a sharp needle consists in the wounding of a vein or artery. The risk from this source is not great, though there has been reported one case at least of death from hemorrhage by the puncture of a vessel by a sharp glover's needle. One sees not infrequently during the suture of an abdominal wound considerable hemorrhage from a stitch-hole, either through the hole itself or subcutaneously. Suppuration in the line of the abdominal incision is not infrequent, even in aseptic operations. It comes usually from a septic suture and results in a superficial abscess, though the structure of the abdominal wall permits in some instances extensive burrowing. Fortunately, the pus rarely makes its way into the abdominal cavity, so that even in the presence of a very considerable stitch-hole abscess little fear of general infection is to be apprehended. A stitch-hole abscess should be opened early and freely.

The abdominal parietes, in addition to being the seat of injuries, cuts, contusions, etc. (described under Gunshot Wounds), are sometimes the seat of new growths. These may be fibromata, carcinomata, sar-

comata, or lipomata, either originating in the abdominal wall or invading it by extension. Carcinoma rarely, if ever, appears primarily in the abdominal wall.

The commonest form of tumor in the abdominal wall is the fibroma. This probably starts in the fibrous aponeuroses of the abdominal muscles. It presents itself in the shape of a firm, smooth, symmetrical swelling, usually in the lower portion. The fibroma may attain considerable dimensions, filling even a whole quadrant and simulating an intraperitoneal growth.

Next in frequency of occurrence to the fibroma is the fibro-sarcoma of the abdominal wall. The diagnosis between this tumor and the fibroma cannot be made except by exploration and microscopic examination. If the development of the tumor is rapid, it is probably sarcoma.

Benign growths of the abdominal wall may exist for many years without giving rise to uncomfortable symptoms.

It is essential to distinguish between tumors of the parietes and intra-abdominal growths. The local signs usually enable one to make a diagnosis, for in the former the tumor is not separated from the hand by the thickness of the abdominal parietes. When there is a thick layer of fat or when the abdominal muscles are very thin, it is sometimes impossible, without an exploration, to make a differential diagnosis.

The **treatment** of tumors of the abdominal wall depends upon their nature. The chief objection to removal is the consequent weakening of the parietes. Thorough extirpation in some cases means the total ablation of a large portion of the whole muscular wall, with an inevitable hernia of great extent. One should for this reason hesitate before advising the removal of an extensive benign tumor. Malignant tumors, however, must be extirpated without regard to this disadvantage. When a malignant tumor is extensive and infiltrating the possibility of its successful removal is remote. In such cases palliative treatment, or treatment by erysipelas toxines, by Coley's method, may be used at times with great advantage. In one case of this kind a tumor of the left lower quadrant of the abdominal wall was so thoroughly dissipated by Coley in two or three months that no vestige of the growth remained. In this case the diagnosis was made by the microscope at the Harvard Medical School. A year later a hernia appeared in the exploratory cut, through which a portion of the growth had been removed for examination.

Tuberculosis of the abdominal wall, though very rare, occasionally appears in the form of a diffused tumor, either starting in the sheaths of the abdominal muscles or extending from the peritoneum. Two instances of this kind in the writer's experience so strongly simulated a hopeless abdominal growth that the wisdom of exploration seemed questionable. An extensive tubercular infiltration was found of the sheaths of the abdominal muscles, extending from the costal cartilages to the groins on both sides. The muscular sheaths were curetted through a very extensive crucial incision. Recovery followed.

APPENDICITIS.

By FRANK HARTLEY, M. D.

To within a few years the symptoms of appendicitis were explained by the name of typhlitis. The author of this name for the disease was Albers of Bonn, who classified the disease as being one of four stages—namely, a stercoral, an irritative, a perityphlitic, and a chronic typhlitis. The idea of Albers was a purely theoretical one, and was not substantiated by autopsy. His theoretical teaching, however, was believed and made use of in practice from 1838 to 1886, with a few exceptions in which investigators reported cases of appendicitis.

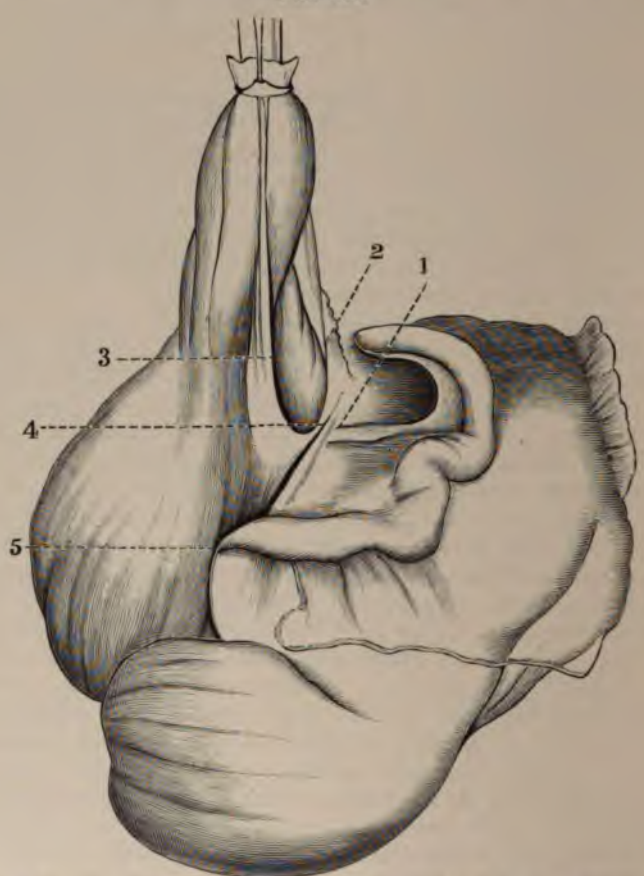
Earlier than Albers, Mestivier (1759) reported a case of traumatic appendicitis due to a pin. Wegeler (1813) added a case of stercoral appendicitis, with a foreign body, a fecal concretion, weighing a gramme. In 1827, Melier gave a most perfect description of the forms of appendicitis, including both the perforative and the recurrent varieties. The descriptions of the appendicular pain and the perforation with consecutive complications were nearly as perfect as we know them to-day.

Melier seems also to have foreshadowed the treatment for this affection, for he says that if it were possible to establish the diagnosis accurately surgical interference should be used, and he intimated that such a course would some day be pursued. This result has been brought about by American surgeons. They have firmly established the view of Melier as to the importance of the appendage as the seat of disease, and of the necessity of surgical interference. Among the Americans no one deserves more credit than Reginald Fitz of Boston, who in 1886 published in the *American Journal of Medical Science* an article in which were collected 209 cases of typhlitis and perityphlitis, together with 257 cases of perforative appendicitis. He showed the similarity in their symptomatology, the frequency of fecal concretions in the appendix, the complications, and the benefits to be derived from operation. Biermer (1879), Matterstock (1880), Talamon (1882) antedated Fitz in writing up the rôle played by the appendix in the inflammations in the right iliac fossa, but no less credit can be given Fitz, for he insisted upon and proved to the profession by a second article (1888) that these conditions, known as typhlitis, perityphlitis, paratyphlitis, perityphlitic abscess, and appendicular peritonitis, were only phases of the same disease. To H. B. Sands should be given the credit of the first operation during an acute attack for the demonstration of the principles laid down by Fitz.

It is only during these last few years that the vermiform appendix can be said to have attracted considerable attention as the seat of the inflammatory processes in the right iliac fossa. In the more recent investiga-

tions we have found that the cæcum is involved only once in two hundred times as compared with the vermiform process (McMurtry), and once in forty-seven times (Roux). The part played by the cæcum is only a secondary one. Though frequently covered by false membrane or perforated by the appendicular abscess or filled with fecal matter or gas due to the atomy induced by over-excitation from the appendicular disease, it is considered to be in this condition as the result of the appendicitis.

FIG. 248.



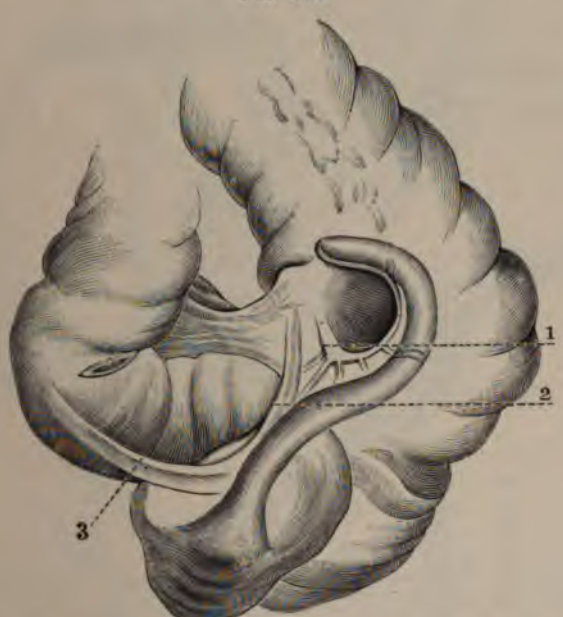
Human cæcum and ileo-colon, adult: 1, posterior vascular fold at the beginning of the distal free portion, constituting the appendicular mesentery; 2, proximal segment of posterior vascular fold fused with 3, non-vascular intermediate fold; 4, rounded edge at union of posterior vascular and intermediate non-vascular folds, bounding entrance into ileo-colic fossa; 5, point of accession to the appendix of the main appendicular artery derived from the posterior cæcal branch (Huntington).

The appendix is a diverticulum of the large intestine which is attached to the postero-internal face of the caput coli. It is an atrophied organ, a rudimentary vestige, which in man represents the well-developed cæcum of the herbivora and the graminivora. It is useless to attempt to explain the physiological rôle played by the appendix. All we know about it is that in embryonal life it is a part of the large intestine,

and at birth atrophies to such extent as to render variable its size, length, and position. The appendix is in many instances a very freely movable organ, and presents the greatest variety in its situation. The variability in position, while dependent in part upon its length and the character of its mesentery, is, nevertheless, dependent in some cases upon a purely congenital abnormality involving the ilio-cæcal portion of the large intestine. In this variety the cæcum is small and of a fœtal type. It is situated high up in the abdomen over the right kidney, with the appendix arising from its apex. The cæcum and lower few inches of the ilium have no mesentery, but are bound down closely to the posterior abdominal wall. The appendix, however, has a distinct mesentery.

Besides this type, spoken of by some as the main congenital abnormal type, there are what many consider the normal positions for the appendix,

FIG. 249.

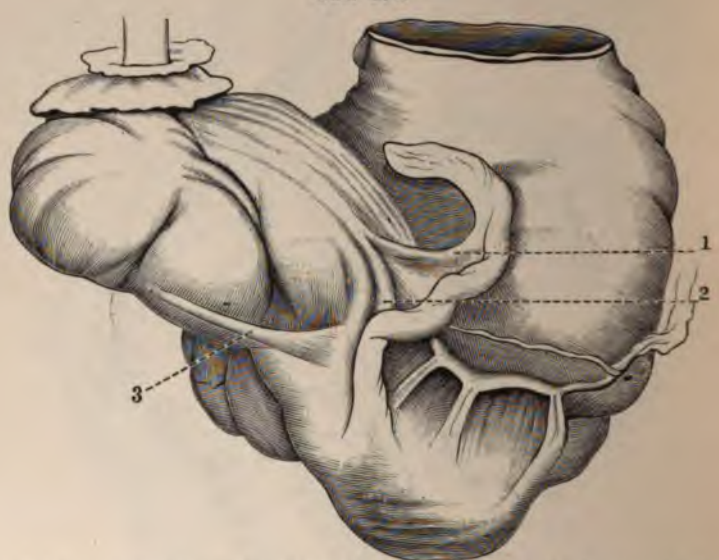


Adult human cæcum and ileo-colon, posterior view: 1, distal, and 2, proximal appendicular artery, derived from the posterior cæcal division of the ileo-colic artery, and running in the posterior vascular folds; 3, intermediate non-vascular fold, exhibiting the beginning fusion with 2, anterior cæcal artery not developed (Huntington).

which are not dependent upon a congenital abnormality. These positions are those in which the appendix is most frequently found. Bryant collected 144 cases, in 89 of which the appendix was directed upward and combined with a turn to the inner and less frequently to the outer side. Turner in 105 cases found that the appendix was for the Tartar race more frequently directed downward. Huntington in his *Studies in the Development of the Alimentary Canal* maintains that these two types represent the main ones, and ascribes much to heredity in the production of one or the other type. From the examination of the Atelesater,

Mycetes fuscus, the Cercopithecus, and the human embryo in the embryological development of their cæcum, ilium, and the appendix, the author of this article shows that the early colic adhesion to the posterior parietal peritoneum produces the post-cæcal position, while the postponed or delayed early adhesion, on account of the continued interposition of the small intestine, gives rise to the pendent cæcum and appendix. Moreover, the slope, direction, and position of the appendix are dependent upon the disposition of the posterior vascular and non-vascular intermediate folds of peritoneum between the ilium, cæcum, and the appendix—*i. e.* the mesenteriolum. In the majority of instances the turn of the cæcum to the left, the approximation of the colic junction and the root of the appendix, with the increase in the right half of the cæcum, are dependent upon the early amalgamation of the non-vascular intermediate with the proximal portion of the posterior vascular fold.

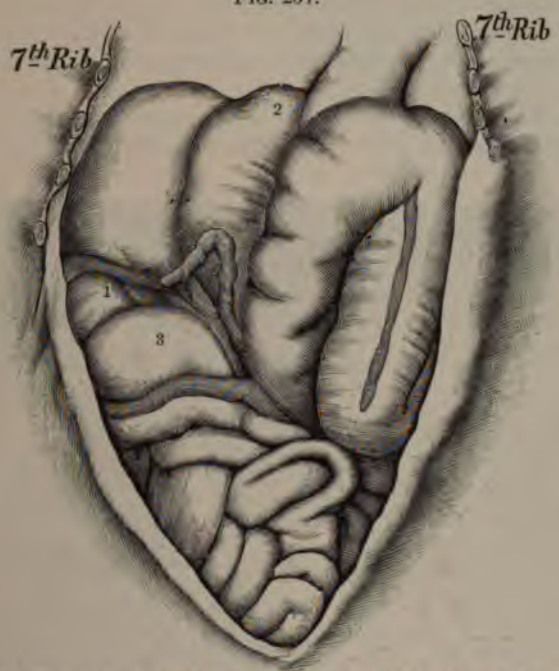
FIG. 250.



Human adult cæcum and ileo-colon, posterior view: 1, distal appendicular branch of posterior cæcal artery, running in mesentery of appendix; 2, proximal branch of same vessel turning downward to the root of the appendix; 3, non-vascular intermediate fold (Huntington).

The curves, bends, and kinks in the appendix depend upon the slow increase in size of the tube between points which are fixed at an early date. One of these fixed points is afforded by the accession of the main post-cæcal branch of the ileo-colic artery to the appendix. The other fixed point is to be found where fusion between the proximal portion of the posterior vascular and the intermediate non-vascular fold terminates. The distal portion of the posterior vascular fold continues to the apex of the appendix as a free mesentery. The point of accession of the posterior ileo-colic branch to the appendix is rendered the most fixed portion of the tube and the one where bends and twists are the most apt to occur. The cause of the shortening of the posterior vascular fold is due to the gradual descent and subsequent backward curve in the cæcum. The

FIG. 251.



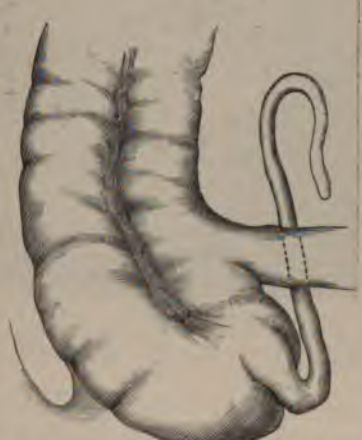
1, appendix; 2, duodeneum; 3, cæcum—cæcum is rotated outward. Appendix crosses kidney and duodeneum extraperitoneally situated, until one inch from apex it becomes intraperitoneal (Sonnenberg).

appendix, modified in shape and relations by these serous reduplications

FIG. 252.

Appendix situated behind the cæcum; extraperitoneal until one reaches the bend, when it becomes intraperitoneal (Sonnenberg).

FIG. 253.



Appendix with funnel-shaped origin passing behind the ilium and toward the hilus of the kidney. Intraperitoneal, except behind the ilium (Sonnenberg).

described, has a natural curve which, after the completed rotation of the

intestine, presents its concavity to the left. Hence we expect to find two main positions—the first, upward behind the cæcum, to the left or right side; the second, downward away from the cæcum, to the inner or outer side.

Statistics maintain this view of the two principal types. Ferguson in 123 cases found 19 cases in which the appendix lay to the right

FIG. 254.

Appendix 9½ inches long, intraperitoneally situated and ascending along the inner margin of ascending colon, over the kidney, to the lower border of the duodenum, where, bending upon itself, it descends to the internal and inferior angle of the kidney (Museum, Carnegie Laboratory).

of the cæcum; 11 in which it lay below the cæcum; 18 in which it lay to the inner side; 75 in which it lay behind the cæcum. Hartley in 15 cases of excision of the appendix found 8 cases where the appendix lay behind the cæcum: 1 behind and to the inner side; 1 below and partially behind; 1 below and in connection with the anterior abdominal wall: 1 below and upon the anterior surface of the cæcum; 1 to the

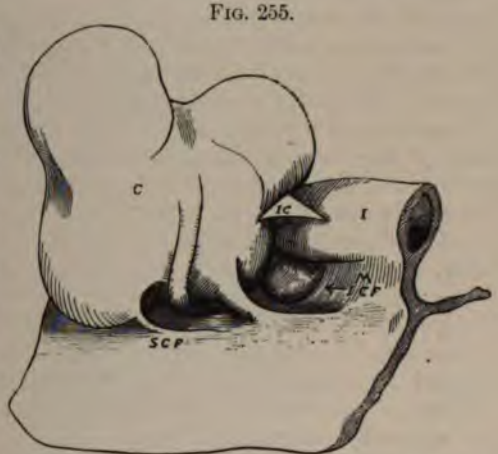
inner side, below and upon the brim of the pelvis; 1 to the inner side of the cæcum; 1 upon the anterior surface of the cæcum.

Biggs maintains from his autopsies, directed with this end in view, that in a little less than three-fourths of the cases the appendix was shown to be below and to the inner side, and in a little more than one-fourth the appendix was situated behind the cæcum and the ascending colon.

In addition to these main types of position, we may find, as the result of inflammatory adhesion, the appendix in other positions. Such cases are noted as showing, in a number of instances, adhesion of the appendix to the ilium, forming even a constricting band about it. Adhesions binding the cæcum, the rectum, the bladder, the ovary, or the anterior abdominal wall to the appendix are also seen, and give it abnormal positions.

It should also be mentioned here that the escape of the appendix in the sac of an inguinal hernia or into one of the ilio-cæcal fossæ is not to be overlooked in any classification of its abnormal position.

FIG. 255.



C, cæcum; *I*, ilium; *I.C.F*, ileo-cæcal fossa; *S.C.F*, sub-cæcal fossa (Kelynack).

Anatomically and pathologically, the length and relative size of the lumen of the appendix are important. In an examination of 200 appendices by Ferguson the medium length was 4½ inches, with a diameter of a No. 9 sound of the English scale. In 3 of the cases the appendix was ½ an inch in length, and in 1 case no trace could be found. Fitz states that the longest appendix he has seen was 6 inches. Sappey says that the length is variable, and ranges between 6 or 8 centimetres and 10 centimetres. Merling describes one case as a small tubercle. Many others say that the length varies from 25 to 30 centimetres. Kelynack in 177 cases found the average length to be 3½ inches.

Variations in the lumen are very important, and among the important points which may be variable is the appendico-cæcal orifice. A small orifice here admits fluid fæces and hinders or prevents the egress of semi-solid material. At this point the lumen may range between a mere pin-hole and No. 7 catheter, English scale (Kelynack). Lockwood and Rolliston examined 104 cases for the purpose of determining the size of the lumen of the appendix, and found in 7 instances a complete obliteration, and they state that "the appendix is frequently found partially impervious in old people for its distal third or half." In the various portions of the appendix the lumen varies from the diameter of a fine probe to that of a quill.

Ribbert found in 400 cases that in 99—*i. e.* 25 per cent.—the appendix was partially or completely obliterated. At the points of oblitera-

tion one finds the mucous glands have disappeared, while the other coats remain undisturbed. This obliteration extends from the peripheral toward the proximal end, but is only in exceptional cases complete (16 in 99 cases). In the first ten years of life only 4 per cent. show these evidences of irregularity in the lumen, while at sixty years more than 50 per cent. are found to have them. From this great difference between the length and diameter of the appendix we can easily see the reason why it is so often the seat of disease. With a process which is on the average 8 cm. long and 5 mm. in diameter, and the lumen of which in 25 per cent. of all cases is partially obliterated at some portion, the mechanical conditions are favorable to a stagnation of its contents and an acquired predisposition for inflammatory involvement.

The manner in which the appendix is covered by the peritoneum is important. Although Ferguson reports 77 cases out of 200 cases as having the peritoneum so disposed as to allow an immediate involvement of the subperitoneal tissue by its perforation, Maurin reports all of his cases as being completely surrounded by peritoneum. Kelynack also asserts that in all his cases the appendix was "a truly intraperitoneal organ." It is very probable that some of these cases reported as being extraperitoneally placed appendices are only appendices herniated into some of the fossæ at the junction of the ilium and cæcum (the superior and inferior ileo-cæcal and the subcæcal fossæ), or are partly intra- and extraperitoneally placed. (See Figs. 5 and 6.)

Histologically, the appendix consists of a mucous, submucous, muscular, and peritoneal coat. Its mucosa consists of a fine meshwork of fibres with cells. Continuous with this reticulum are the lymphoid follicles or lymphoid tissue, for they are not distinctly aggregated in masses. This tissue is relatively very abundant, so that the appendix has been likened by some to the tonsil. The mucous glands vary greatly in number. They are often absent at those points where Ribbert describes the appendix as undergoing evolution. The terminal portion of the appendix is thick and extremely fibrous, and it is here that the glands are often absent.

The submucous coats consist of an areolar tissue in which are seen numerous blood-vessels, nerve-filaments, and lymphatics.

The muscular coat consists of an inner and an outer layer. The inner layer forms the greater part of the mass of the appendix, and consists of a fine fibrous tissue arranged in a circular manner for the most part, with a smaller amount of muscular fibres. The outer coat is mainly made up of fibrous tissue, with distinct bundles of longitudinal muscular fibres. These two layers vary a great deal. Sometimes they are very thin; at other times they are exceedingly thick. The size of the lumen does not seem to bear any relation to the thickness of the wall. The peritoneal coat forms a complete covering almost meeting along the inner border to form the mesenteriolum.

The lymphatics are arranged as in the intestine, and enter the mesenteriolum, where a lymphatic gland is sometimes present. They finally pass into the lymphatics of the mesentery of the small intestine. The arteries supplying the appendix and cæcum are the anterior and posterior branches derived from the ileo-colic. Of these, the posterior branch passes along the border of the mesenteriolum as far as its lower fourth,

where it leaves the mesenteriolum to pass to the appendix in terminal branches. The nerves are arranged as in the intestine; they enter the mesenteric plexus.

It may be interesting to note that in one in ten cases a process of peritoneum passes from the right ovary to the meso-appendix, called the appendiculo-ovarian ligament of Clado. It contains lymphatics passing between the ovary and the mesenteriolum of the appendix, as well as a small artery. It is believed by some that this will afford a certain immunity against the disease by increasing the blood-supply. This is,

FIG. 256.

Appendix containing biliary calculus (Museum, Carnegie Laboratory): 1, biliary calculus.

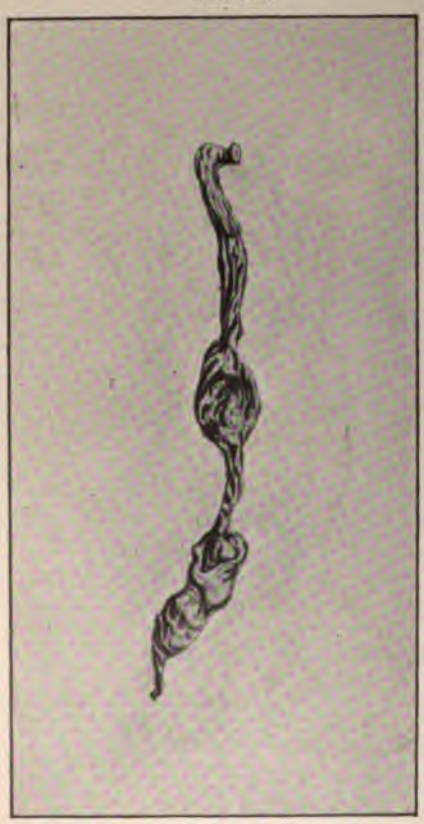
however, a purely theoretical deduction and at present has no weight. From the histology we see that the appendicular mucous membrane and the arterial and lymphatic supply are similar to those of the intestine, and especially so are the mucous membrane and the lymphatic tissue.

Any excitation involving the mucous membrane provokes an abundant secretion, and within a short time fills the lumen. The swelling of the mucous membrane, in addition to the mechanical constrictions already mentioned, tends to narrow and entirely close the lumen at points where duplicatures of the mucous membrane exist—namely, Gerlach's valve—and where twists or angles occur within the appendix. The appendix,

being a contractile, but inextensible, organ, under the above conditions is subjected to the greatest strain to relieve itself of its contents. It becomes a question in any particular case where these demands are thrown upon the appendix whether the muscular power and the elasticity in the walls can overcome the obstruction before partial or total gangrene occur. This may be modified, provided foreign bodies are already present within the appendix to act as an additonal obstructing and compressing agent.

The frequency of appendicular lesions has been a matter of investigation by a number of men. Hektoen in 280 cases found 42 times adhesions representing periappendicular lesions—*i. e.* 15 for every 100 cases. Maurin in 112 cases found 16 times periappendicular adhesions without any evidences in the histories to point to the fact. Taft, who examined both the interior and exterior of the appendix in 300 cases, has found evidences of appendicular lesions in the proportion of 36 to 100 cases. Ferguson in 200 cases found that 7 cases showed adhesions and 15 cases foreign bodies. We may assume with fairness that about twenty in every one hundred autopsies will give evidences of either intra- or periappendicular lesions. The presence of fecal concretions and foreign bodies within the appendix has long been looked upon as an important etiological factor in setting up inflammatory processes.

FIG. 257.



Appendix containing two fecal concrements: case of perforative appendicitis, the perforation opposite the distal concrement (Museum, Carnegie Laboratory).

Fitz in 152 cases found in 47 scybala, and in 12 cases foreign bodies; Matterstock in 169 found that 53 per cent. contained scybala and 12 per cent. foreign bodies; Krafft in 40 cases found in 36 fecal concretions and foreign bodies in 4 cases; Maurin in 60 cases found in 34 cases fecal concretions and in 26 foreign bodies; Ferguson in 200 cases found in 15 foreign bodies; Fenwick in 69 cases found 55 containing foreign bodies, and 14 containing fecal concretions.

Talamon has collected the statistics upon this point, and has found that, in 760 cases, in 450 a foreign body was found in the periappendicular pus or within the appendix—*i. e.* in nearly two-thirds of the cases. Sometimes the foreign body was pointed, as a pin or fish-bone; sometimes it was the seed or the kernel of fruit or a biliary or intestinal calculus, but most fre-

quently this body was found to be a fecal concretion. There can be no doubt but that the abnormal contents are most frequently found to be fecal masses infiltrated with lime salts. The general belief in reference to the origin of these concretions is that there exists in life an appendicular passage of fæces so long as the appendicular peristalsis is uninterrupted. If this be the case, the fluid or semifluid fæces being retained and coming in contact with the large absorbent surface of the appendix, the watery part is rapidly absorbed. From its increase in size alone a concretion may cause pressure enough to produce a local or total gangrene, or it may, under certain circumstances, induce a catarrhal appendicitis, and the secreted mucus may, by its deposit of the carbonate and phosphate of lime, add to this mass until it becomes incarcerated and produces by pressure on the wall of the appendix a local or total necrosis.

FIG. 258.

Funnel-shaped cæcum and appendix, gangrenous appendicitis: 1, fecal concrement; 2, mesenteriolum; 3, appendix, situated behind and to inner side of cæcum; 4, ilio-cæcal junction.

Talamon, on the other hand, believes that the cæcum is the probable place of origin of these concretions. He believes that particles of fecal matter, detached from the fecal bolus or deposited in the anfractuosities between the longitudinal bands of the cæcum, become rounded and enter the appendix. Having entered the appendix abruptly, as the result of an intense contraction of the cæcum it injures the walls, obstructs the lumen, and compresses the wall of the appendix, interfering with its blood-supply. These conditions aid a retention of the glandular secretion of the mucous membrane and diminish the vitality of the organ. The microbes, innocuous in the normal state of the tissues, triumph in tissues deprived of their vitality. He believes this to be the mode of action of the concretions if we leave out of account the pointed foreign bodies and the ulcerations following syphilis, typhoid fever, tuberculosis, actinomycosis, and malignant disease.

We should bear in mind the possibility of fæcal matter or a foreign

body inducing an inflammation and then being forced into the cæcum by peristalsis. In one-third of the cases no foreign body was found, and at present it is enough to say that in these cases it may not have been noticed by the operator, had fallen back into the cæcum from the relaxation of the tension at the time of perforation or into the periappendicular abscess, or had been softened and transformed into a semisolid mass while in the appendix by the accumulated secretion or in the periappendicular abscess by the transudate. Foreign bodies or fecal concretions found in the appendix where no attacks have occurred have failed to produce an obliteration of the lumen and a compression of the walls. The concretion within the appendix only aids the proper development of the microbes in that it produces by pressure a local or total diminution of the vitality of the tissues.

The bacteriology of the intestines is still obscure, for we do not know yet but that some of the so-called species are attenuated varieties of other groups. Their morphological differences are slight and often inappreciable, since they are polymorphous. Their differences in culture are often very small, so that mistakes can be easily made. There appears, nevertheless, to be one variety which is independent of the rest. This is the bacillus coli communis (Escherich's). It is found in the normal state in the mucus of the large intestine. According to some investigators, this bacillus is able not only to cause simple inflammatory lesions, but even suppurative ones. Laruelle declared that this bacillus was the true agent of perforative peritonitis. A. Fränkel found it 6 times in 31 cases of peritonitis; Barbacci in 4 cases of perforative peritonitis found this bacillus in the peritoneal exudate and in the blood of the heart and vessels. Welch found it present in 6 cases, 4 of perforative and 2 of non-perforative peritonitis. He has never seen it outside of the intestine when healthy. He gives it a pathogenic property under special conditions. Malvoz found the bacillus in 6 cases of peritonitis of intestinal origin. One case was a generalized fibrino-purulent peritonitis consecutive to an appendicitis without perforation. These facts prove its frequency, and Malvoz and Welch demonstrate the fact that there need not necessarily be a perforation to produce the peritonitis in the fluid of which it is found.

The experience of Laruelle and Fränkel seems to establish the fact that pure cultures, unless mixed with intestinal fluid or bile, do not cause peritonitis. In perforation of the intestine these conditions are realized, but further research is necessary to establish the mode of reaction of the peritoneum in the presence of the bacillus alone. Roswell Park maintains that the bacillus coli communis is able to diffuse itself over the entire body, and cause either a fibrinous, serous, purulent, or septic peritonitis with or without the development of gas. Fränkel, Welch, and Hodenpyle have found associated with bacillus the streptococcus pyogenes, the staphylococcus pyogenes, and in one case the bacterium lactis aërogenes. It is probable that more minute examination will show other varieties of micro-organisms. It does not therefore appear justifiable to ascribe to the bacillus coli communis alone the pathogenesis of perforative peritonitis. It is but just to think that in some cases one of the varieties may modify the character and the result of the peritonitis when it is the predominant factor.

The mechanical obstructions to the lumen of the appendix, the appendicular concretions, and the microbic infection are sufficient to explain all forms of appendicitis. The foreign matter can, when large in amount, especially if an inflammatory swelling be present, so disturb the circulation in the walls as to be an important factor in the ultimate result. Except in rare instances we do not believe that this foreign body has just entered the appendix, and as a result has induced the pressure. We do believe, however, that there is a constant appendicular passage of fæces in many cases, and fecal concretions and deposits of the salts are gradually produced, until either by its pressure it produces an ulcer or by injury a tear in the mucous membrane. The microbes enter the appendix with the fluid contents, and, finding thus a favorable nidus, provoke an inflammatory swelling in the wall of the appendix with an increase of mucus in the lumen. Under these conditions the added inflammation contributes wholly or in great part to the constriction of the appendix and its partial or total death. The appendix is, moreover, an organ in the process of evolution, and kinks, rotations upon its long axis, and veritable strictures occlude in part its lumen. The appendix, not being able to distend sufficiently to relieve the tension on its wall from the increase of mucus, and being unable to extrude its contents from the mechanical obstructions, as well as from its loss of muscular power due to the œdema of its wall, must suffer strangulation wherever the inflammatory process is the greatest. Under some conditions this necrosis will involve a limited area or areas, and in other conditions will be complete for the whole appendix. What is spoken of as a catarrhal appendicitis, acute or chronic as compared with those inflammatory lesions in which more than the mucous membrane is involved, is rare. It is possible that what is called appendicular colic and the acute catarrhal appendicitis are in many instances one and the same process. Although the cases reported by Binnie, Von Hochstetter, and Kamerer go to show the possibility of an appendicular colic either from foreign concretions or contained mucus in the appendix, they also show that the series of symptoms attributed to the colic do exist with evidences of an acute or chronic inflammation, and likewise show our inability to differentiate these conditions.

Cases in which the appendix has been removed in the first twenty-four or forty-eight hours have shown a simple inflammation, involving only the mucosa, and, at most, the submucosa. Similar cases have been allowed by me to run for forty-eight to seventy-two hours, and have then been removed, with the same pathological condition present. Yet these cases are rare as compared with those which do not stop at the involvement of the mucosa. By far the greater number of acute appendicites are parietal—*i. e.* involve the whole wall—for when operated upon on the second and third day of the attack the walls are completely involved, with a roughening of the peritoneal coat and soft adhesions to the surrounding tissues. Within forty-eight to seventy-two hours the inflammatory process has propagated itself beyond the muscular, and has involved the peritoneal, coat. The appendix appears erect and increased in volume. The walls are thick, and the cavity is enlarged below a twist, kink, or stricture. Within the cavity is either a viscid mucus or a muco-purulent fluid. The microscopical examination shows

the vessels of the mucosa and submucosa dilated and filled with red blood-cells. The tubular glands are filled with large cells and the interstitial tissue is infiltrated with embryonal cells. This infiltration continues between the fibres of the muscular coat, and spreads out into the subserous coat either as a discrete or diffuse mass of cells. The endothelial cells of the peritoneal coat are partly desquamated or greatly increased in number and volume. Such cases may resolve, or this may be the first stage of a suppurative appendicitis, or, if no suppuration occur and the resolution be imperfect, it may be chronic. It is probable that this chronic evolution is consecutive to an acute attack in many instances, especially in the recurrent appendicitis. The pathological conditions following the primary attack decide the completeness or incompleteness of the recovery. If slight, and especially if no extensive lesions of the nerves and arteries (peri- or endoneuritis or endarteritis obliterans) or stenosis of any portion of the appendix either from twists or strictures exist, all traces of the process may disappear. When these are present the mechanical obstruction, the lowered vital resistance, and the micro-organisms in the retained secretion (a good culture-medium) result in a subacute, acute, or chronic form of appendicitis. In the chronic form (recurrent appendicitis) the appendix appears augmented in volume. Its walls are indurated and hypertrophied. The external coat may be uninvolved or adherent to the neighboring coils of intestines, omentum, abdominal wall, or the iliac fascia. The cavity is dilated, and contains a small amount of thick mucus under tension. The mucous membrane is smooth and apparently healthy, while the submucous, muscular, and peritoneal coats are involved in the chronic inflammatory process. At other times, and most frequently, the cavity is partially constricted by a stricture or angular bend at the junction of the intermediary and posterior vascular layers of the peritoneum, extending between the cæcum and the appendix, below which a marked dilatation of the lumen exists. In rare instances the appendix is a firm, hard cord, with its lumen irregularly constricted or obliterated and lost in a mass of fibrous adhesions.

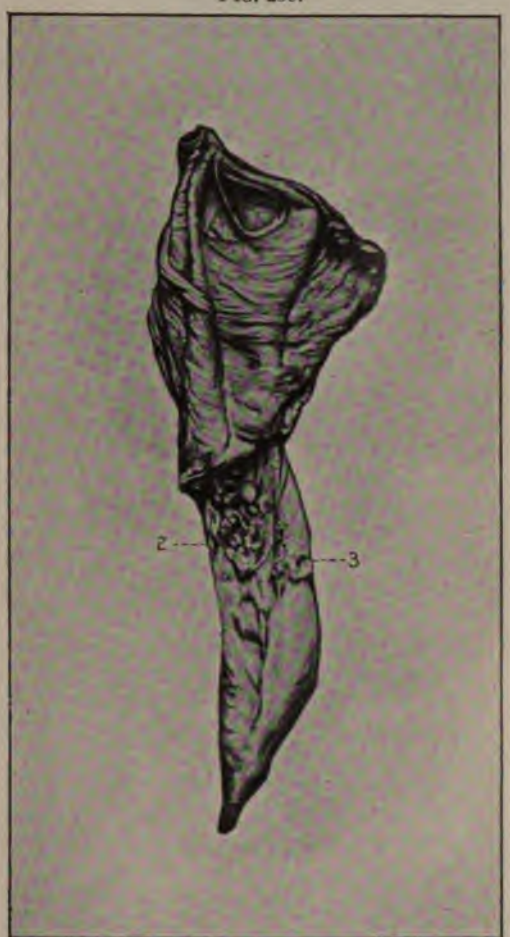
Suppurative lesions in the appendix are frequent, though not often seen at any early stage, and confined alone to the walls. In this class the coats of the appendix are infiltrated with small collections of pus-cells, with the peritoneal coat slightly covered with desquamated cells and possibly a few soft adhesions (see Fig. 259). These cases are rarely seen, because not subjected to operation at an early date. Ordinarily, when the surgeon interferes, he finds the appendix infiltrated, partially or completely perforated and lying in a periappendicular pus-cavity.

Gangrenous appendicitis is really the most important, and more common than the preceding. When a foreign body or fecal concretion is large and near the base of the appendix, the gangrene is complete and rapid in its course. The circulatory disturbance caused by the foreign body and the intensity of the inflammation effect a venous stasis with œdematous infiltration of the walls and a total or partial necrosis. This is followed by a perforation or a total necrosis of the appendix. It is a moist gangrene, a destruction of the tissue by micro-organisms.

The perforations may be single or several. They are often so small

as to be recognized with difficulty. Their situation is not always opposite the foreign body; it is often in its neighborhood or below it. The perforation occurs at the point of least vital resistance, which has yielded more rapidly to the micro-organisms and to the pressure within the appendix either from a fecal concretion or the retained secretion below the twist, kink, or stricture. This is the condition found when the perforation is followed by an acute general peritonitis. If the peritonitis is circumscribed, however, and the gangrenous process has time to go on, the destruction is total and the detached appendix is found in the purulent cavity.

Fig. 259.



Suppurative appendicitis, abscess of appendicular wall, perforation, localized suppurative peritonitis: 2, ruptured abscess of wall; 3, extension of a suppurative focus (Museum, Carnegie Laboratory).

Periappendicular Lesions.—Normal anatomy has shown that of 200 cases, in 77 the appendix was in intimate connection with peritoneum over the iliac muscle or retroperitoneal cellular tissue, such that an extension to the cellular tissue was the most probable result (Ferguson). Whether these cases were those of intra- or extraperitoneally placed appendices is a question not yet decided; yet we must admit, clinically, that we have processes starting in the appendix which from the beginning seem to involve the sub- and retroperitoneal cellular tissue. The possibility of a periappendicular cellulitis must be admitted, but we must also admit that the peritoneal involvement is incontestably the more frequent.

Partial fibrino-plastic adhesive peritonitis accompanies the parietal appendicitis and, at least, the first stage of the other varieties until perforation takes place. It begins early, and is marked in thirty-six to forty-eight hours, binding the appendix to the neighboring structures. It has its useful purpose in limiting the result of a later perforation. Should perforation occur, it localizes for some time the encysted purulent appendix. Such fibrino-plastic exudates may be absorbed. This is the

variety in which complete resolution follows when treated expectantly. It is often spoken of as a suppurative process, the pus of which has been absorbed through medicinal agents.

Such exudates may occur about an appendix the walls of which show no perforation. The appendicitis is parietal, and the bacillus coli communis has penetrated the wall without perforation. We must not rely upon this as the frequent mode of action, and it should be reserved for a few cases until investigation has settled this point more definitely.

Partial or circumscribed purulent peritonitis is the most common result of appendicitis. This is invariably called perityphilitis or pericæcal abscess. In this case either the primary appendicitis has been given a sufficient time for the formation of adhesions or these adhesions have been present from a former attack. The position of the purulent collection will depend upon the situation of the appendix at the time of its involvement. This purulent collection consecutive to perforation is by far the more frequently intraperitoneal. In a minority of cases it is extraperitoneal, involving the retrocæcal or iliac tissue. When the appendix is situated upon the iliac fossa the collection will be found in the inferior portion of this fossa, and, whether intraperitoneal or not, may extend in the subperitoneal tissue and open beneath Poupart's ligament, or, remaining within the abdomen, present at and near the anterior superior spine of the ilium. When the situation is in the smaller pelvis the collection tends to accumulate between the ilium, rectum, and bladder, and above the vagina in the female. If a spontaneous opening occur, it takes place more frequently into the rectum than into the bladder or vagina.

When the situation is in front and internal to the cæcum the collection takes place above and internal to the iliac fossa in the neighborhood of the umbilicus. If the situation be behind, or behind and to the outer side of, the cæcum, pus collects and tends to form a swelling in the costo-iliac or lumbar region. Whether the appendix was intra- or extraperitoneal, whether herniated into the subcæcal or ileo-cæcal fossæ, is a matter of little importance, since the abscess acts as if always cellular. Surrounded anteriorly by the cæcum, laterally and posteriorly by thick muscular walls, it does not tend to open externally. It may extend upward, come in contact with the inferior surface of the liver, perforate the diaphragm, and cause a purulent pleurisy, or, extending downward into the iliac fossa, open into the cæcum or colon. These are the more frequent situations for the purulent collections. The rare situations are those where the appendix was situated in hernial sacs or, from malposition of the cæcum, in front of the kidney, below the gall-bladder, or in the left iliac fossa. As complications of the purulent collections may be mentioned—(1) thrombosis of the iliac vein with œdema of the lower extremity and a possible fatal pulmonary embolus; (2) a fatal hemorrhage from ulceration of the iliacs or circumflex iliac arteries; (3) pylephlebitis (11 : 257), giving rise to symptoms in the midst of which those of the appendicitis are not apparent; (4) thrombosis of the ileo-colic vein and multiple or single abscess of the liver; (5) suppurative lymphomata of the mesenteric glands; (6) a diffuse cellulitis of the retroperitoneal tissue with intense sepsis.

If adhesions have not been formed or if insufficiently resisting and

perforation takes place rapidly within forty-eight to seventy-two hours, the peritonitis becomes general. If the perforation is at first localized, either from the rupture of the purulent focus or by a gradual progression, the peritonitis has the same tendency to become at once a general one, or, by a more gradual advancement, a progressive or progredient peritonitis. In either case the peritoneum presents practically the same pathological changes. The sealing together of the intestinal coils, which are covered with distended vessels and a thick or thin fibrino-purulent exudate, together with the collections of liquid sero-purulent fluid between the coils of intestine, of a special fetid odor and containing at times free gas, are the more common evidences of this variety, and are found most marked in the neighborhood of the appendix. They gradually fade away at a greater distance from the appendix until, at the most remote portions of the abdominal cavity, we find a few adhesions, distended vessels over the intestine, and a serous transudation between the coils. It is true that the lesions are not identical in all instances, and that the quality of exudate varies in different instances as well as in different portions of the abdomen. Can this difference not depend on the duration of the disease and the quality of the micro-organism? The bacillus coli communis does not seem to be the sole cause, and when mixed with the staphylococcus, the streptococcus, or bacillus fœtidus can they not alter the quality of the exudation? Those cases in which death occurs in three or four days with the symptoms of intense sepsis—adynamia with no febrile reaction—and in which the pathological changes consist of no or a few adhesions and a sero-sanguinolent fluid between the intestines, can they be compared with the suppurative variety any more than a diffuse traumatic cellulitis (gangrene) can be to a circumscribed cellulitis? Depending upon the quality and variety of the infection, we then have three varieties of a diffuse and two of a circumscribed process involving the peritoneum: I. Peritoneal sepsis; II. Diffuse fibrino-purulent or ichorous peritonitis; III. A progressive fibrino-purulent peritonitis; IV. Circumscribed purulent peritonitis; V. Circumscribed adhesive or fibrino-plastic peritonitis.

Causes of Appendicitis.—*I. Predisposing Causes.*—(*a*) Atony of the large intestine, resulting in a functional alteration of the character and the amount of mucus, as well as in insufficient contractions, seen especially in the great eaters and in those recovering from typhoid and the eruptive fevers, dysentery, and old ulcerations with cicatrization in the large intestine, pneumonia, fractures, and severe wounds.

(*b*) *Age.*—In the infant appendicitis is rare. This is true for the first two years, but not for the second two years. Four cases have been reported in early childhood: 1 occurred at seven weeks, 1 at twenty-two months, 1 at twenty months, and 1 at thirteen months.

Fitz's Statistics.

From the 20th month to 10 years	10	per cent.
" 10 years to 20 years	38	"
" 20 to 30 years	28	"
" 30 " 40 "	15	"
" 40 " 50 "	3	"
" 50 " 60 "	5	"
" 60 " 70 "	1	"
" 70 " 80 "	0	"

(*c*) Previous attacks of appendicitis, especially where fecal concretions exist, or where strictures, twists, and adhesions are left as the result of the former attacks.

(*d*) *Sex.*—The proportion of male cases to the female is 4 to 1—*i. e.* male, 80 per cent.; female, 20 per cent. There seems to be no other reason for this difference than that atony of the large intestine, overeating, chronic colitis, and exposure to cold are more frequently seen in the male than the female.

(*e*) The anatomical conditions of irregular evolution of the appendix, leaving partial stricture of the mucous membrane, twists, and angular bends, have an important influence in predisposing one to appendicitis.

The Occasioning Causes.—(*a*) Indigestion appears to be a cause, in that the matter in the intestine, taken in excess, poorly digested, and badly tolerated, provokes a catarrh and anomalous constrictions of the intestine.

(*b*) Exposure to cold, by provoking anomalous movements in the intestine, should be arranged among the occasioning causes.

(*c*) Traumatism seems to be a cause in 10 per cent. of the cases. It is not understood by traumatism a blow upon the appendix, but any violent effort. It is not rare to have this cause associated with digestive disturbances, especially in those who after years of inactivity and overeating take up some violent form of exercise (bicycling at present).

Symptoms of Appendicitis.—It is generally observed that the person attacked with appendicitis is an adolescent or an adult who enjoys good health, but has been afflicted with various functional digestive troubles. He is suddenly seized with a general abdominal pain, which soon localizes itself in the right iliac fossa. From this time on several varieties of inflammation may follow, each with a distinctive result, such as—

Acute appendicitis,	(*a*) Catarrhal including appendicular colic; (*b*) Parietal; (*c*) Parietal with adhesive peritonitis.
Acute suppurative appendicitis,	(*a*) Circumscribed fibrino-purulent peritonitis. (*b*) Progressive fibrino-purulent peritonitis. (*c*) Circumscribed fibrino-purulent peritonitis, rather subacute, with suppurative thrombi in ileo-colic veins, and abscess of the liver or mesenteric lymphomata; (*d*) Retrocæcal cellulitis.
Acute gangrenous appendicitis (partial or complete),	(*a*) Peritoneal sepsis; (*b*) Diffuse fibrino-purulent peritonitis; (*c*) Circumscribed or progressive fibrino-purulent peritonitis; (*d*) Retrocæcal cellulitis.
Chronic appendicitis,	(*a*) Recurrent; (*b*) Relapsing.

In any acute involvement of the appendix the symptoms of pain, vomiting, abdominal tenderness, fever, muscular tension of the abdominal wall, with or without constipation or diarrhœa, are present to a variable extent, depending on the intensity of the infection and the course

of the disease. The onset of the attack is, in the majority of cases, sudden. This sudden development of the primary symptoms is so characteristic that in diagnosis ordinarily only those diseases having a sudden onset are considered. The pain is one of the most important of the cardinal symptoms. It is acute and lancinating, and at first referred to the periumbilical or epigastric region. In a few hours it localizes itself in the right iliac fossa. In only one-fourth of the cases is the pain at the commencement of the attack referred to the right iliac fossa. Vomiting is a comparatively frequent symptom. It follows the onset of the pain and is usually accompanied with nausea. It is rare for it to precede the pain. It is looked upon as a reflex phenomenon and not dependent upon any indigestion which may be present. Abdominal tenderness is present in all cases and is present within six hours of the onset. It corresponds very accurately to the location of the appendix in a general way, and when localized in a small area is called point-tenderness (McBurney). In the very commencement of the attack or where a more or less diffuse tenderness exists in the right iliac fossa, with a single point of exquisite tenderness on the external border of the right rectus muscle in a line from the umbilicus to the anterior superior spine of the ilium, this symptom is one of importance. In the absence of other symptoms to corroborate it too much importance must not be placed upon this symptom. In other respects the tenderness corresponds quite accurately to the location of the process.

Fever is generally present at the onset or within a few hours of it. It ranges ordinarily between 37.5° and 39.5° C. The variations of the temperature and the pulse are not reliable as prognostic indications in the uncomplicated cases.

If peritonitis be present to any extent, muscular tension in the abdominal wall is marked. In chronic appendicitis it is generally not present. In acute cases with limited peritonitis it is generally present and confined to the right rectus muscle.

A tumor is not generally present in the chronic cases. In the acute cases it makes its appearance at the end of the first or the second to the sixth day. Chills are infrequent in appendicitis, and in only a few cases do they amount to a rigor. Decided rigors are not prominent, and even in suppurative cases the chills do not occur so frequently as in suppuration elsewhere.

Constipation or diarrhœa is not marked as a symptom, and has no diagnostic importance.

Acute Gangrenous or Perforative Appendicitis.—In this variety we assume that the action of the micro-organism is a direct factor, and the concretion, where it is found, is the indirect factor. The condition produced is one of an immediate death of the whole or a portion of the wall of the appendix without limiting peritonitic adhesions, and an extension of the infection to the whole peritoneal cavity. Ordinarily, this variety takes place in the first attack of appendicitis if we can believe the histories given. I can scarcely believe this statement. I do believe, however, as in recurrent cases is the fact, that precedent attacks have existed, but that they were of short duration, slightly marked, and were considered as an attack of intestinal colic.

The symptoms of this variety may be well described as those which

precede and those which follow the perforation. In the first period, lasting from twenty-four hours to three days, after a too copious repast, debauch, or one of the occasioning causes mentioned, there is a violent attack of abdominal pain, followed sooner or later by vomiting of bilious or partly-digested matter. The pain is at first periumbilical or epigastric, but within a half to a few hours localizes in the right iliac fossa. There may be a marked constipation when the pain is intense, or one or two movements when it is indistinct. The pain reaches its maximum intensity in twelve to twenty-four hours. During this period fever is rarely present. If so, it is of only slight intensity (38° to 39° C.). Spasmodic contraction of the right rectus and oblique muscles as well as the point-tenderness is present. During this period the inflammation in the appendix is at its height. The appendix is attempting to extrude the contained muco-purulent secretion from the mucous membrane, or the concretion, or both.

The second period, which generally begins on the second or third day, but may be delayed to the fifth or sixth day, is signalized by intense pain in the right iliac fossa and its rapid extension over the whole abdomen. The abdomen is flat, but hard and tense upon the right side. Rigid contraction of the abdominal muscles is present. The vomiting becomes projectile, fecal in odor, and yellowish or dark-colored. To this is added a constipation which nothing will overcome. This absolute suppression of the intestinal functions, due to the reflex paralysis of the intestines, is such that, combined with the vomiting, it is very apt to suggest an internal strangulation of the intestine. The bladder and the kidney are subject to some reflex action, so that retention of urine, oliguria, or anuria, with indican and albumin in the urine, are frequent symptoms. The albumin in the urine may be due to the elimination by the kidney of toxic products absorbed by the peritoneum or to the general exhaustion and diminished arterial tension.

The febrile movement is rarely above 39° C.; ordinarily, it is between 38° and 39°. At times it is subnormal, and corresponds to the coldness of the surface temperature. This is probably due to the intense shock. The appearance of the face is characteristic. It is the facies Hippocratica. It is drawn. The eyes are sunken and surrounded by large blue circles. The nose is pinched. The voice is feeble and broken. The general expression in the face is one of anxiousness. The extremities are cold and bluish-white in color. The heart-beats are weak and frequent, and the pulse is without force and very compressible. The patient rests in bed upon the back with the legs flexed upon the abdomen. Every movement produces a violent pain in the abdomen. The respirations are short and dyspnœic. Hiccough is added, which becomes incessant. The thirst is severe. The mouth is dry, and the tongue is a vivid red or covered with a dirty coating. In certain instances the violence and rapidity of the disease are very marked, and a fatal termination takes place on the second, third, or fourth day. In this variety the prostration is extreme. The coldness of the surface and the absence of temperature is a marked feature. The muscles of the abdomen are rigid. Retraction of the abdomen rather than meteorism is present. Oliguria, indican, and albumin in the urine are found in the urinary analysis. The temperature is normal or subnormal. The pulse is small

and frequent. A fatal termination takes place within four days from the time of perforation.

In this variety the severest of all forms of infection has taken place—*i. e.* the peritoneal sepsis. So rapid is that termination that enough time has not elapsed to allow of an extensive exudation. In many cases autopsy shows but a small amount of sero-sanguinolent fluid; in a smaller number no exudation whatever. When the peritonitis is not so violent and is purulent in character the symptoms are less intense in action and less rapidly produced. The temperature is elevated (39° to 40° C.), and is of a remittent character. The abdomen is often tympanitic instead of retracted. The vomiting is less frequent. Constipation is less absolute, while intestinal paresis is not so marked. The urine is less scanty, and indican and albumin may be absent. The pulse is rapid and compressible. The surface temperature does not show the same intense degree of coldness; it is often elevated.

With this symptom-complex varied in degree of intensity occur two forms of peritonitis. The first is the diffuse fibrino-purulent (ichorous) peritonitis, which develops most frequently from a perforative appendicitis, and particularly when a large amount of infectious material escapes into the peritoneal cavity or when the virus enters a peritoneal cavity which has been predisposed to such symptoms from former inflammations. This variety is exceptionally bad, and, as in the former variety, a fatal termination most frequently takes place under the symptoms of a severe sepsis. Though a few adhesions or fibrinous deposits are found, gluing the intestines together, they offer no barrier to advancement of the purulent exudation. The second form is the progressive fibrino-purulent peritonitis. The condition under which this is produced is when a less virulent infection or a diminished amount of a virulent poison enters the peritoneal cavity. From the primary focus this progressive peritonitis in some instances advances by a continuous march of fine pus-channels between the intestines, while the greater portion of the peritoneal cavity is free from inflammatory changes. The fibrinous adhesions soften; the pus advances by slow stages and takes one of two courses. It either advances over the top of the bladder and the neighboring intestines into the pelvis and the left hypochondrium, or it may ascend along the inner or outer border of the ascending colon between the intestines to the under surface of the liver. These two courses represent the modes of progression of the peritonitis. They are frequently combined in marked cases. The mode of advance of a progressive peritonitis is, in my opinion, largely dependent on the position of the appendix at the time of the attack. Where the appendix lies below and to the inner side of the cæcum the peritonitis advances to the left hypochondrium or into the pelvis. When it is situated to the inner side of the cæcum it ascends along the cæcum or across the abdomen to the left side. Where it is situated to the outer side of the cæcum, it ascends between the cæcum and small intestines, and toward the liver. Where situated below the cæcum and toward the anterior superior spine of the ilium, it is generally localized for some time, and when it becomes progressive may adopt either of the modes mentioned. In other instances the picture at autopsy is a different one. The intestines over a greater portion of the abdomen are held together

by adhesions between which purulent foci are situated. The purulent foci are apparently not in connection with one another, and are often found separated by the interposition of several coils of intestine. The course of the disease is more or less protracted, and the purulent foci show a tendency to become inspissated. The fatal termination takes place with the symptoms of a chronic sepsis. In the first variety of purulent peritonitis the death usually occurs within five to eight days. In the second variety it takes place within eight to fifteen days.

While perforation of the stomach or intestine usually sets up a diffuse inflammation, in many instances a perforative appendicitis results in a localized intraperitoneal abscess. This is due to a number of causes, such as the small amount of extravasated material, their solid or semi-solid consistency, the immobility of the appendix from position or adhesions from former attacks. It is especially in recurrent cases, where previous attacks have left fibrous adhesions in the neighborhood of the appendix, that localization of this process takes place. It must be admitted also that perforation in the first attack may occasionally set up a very slowly progressive peritonitis, which will allow sufficient adhesions and prevent diffusion. This condition occurs in about 38 out of 95 cases of perforation (Fenwick).

As we have already shown, perforative appendicitis gives rise in most cases to a more or less general peritonitis or to a localized intraperitoneal abscess. In some cases, however, it must be admitted that this abscess is an extraperitoneal process. Many deny the possibility of such an occurrence as a primary seat of the abscess, but when extraperitoneal abscesses are seen in the neighborhood of the cæcum there is often no doubt that the appendix was the source of this condition.

The **symptoms** characteristic of these two conditions, the intra- and extraperitoneal abscess following perforative appendicitis, will be considered with the symptoms of acute suppurative peritonitis. The symptoms characteristic of the appendicitis with perforation are the same as above detailed, except possibly in their rapidity and intensity.

ACUTE APPENDICITIS.—The **causes** and mode of infection are the same as in the acute perforative appendicitis, but no perforation takes place. The disease begins as a simple catarrh, involving the mucous membrane alone at first, but soon attacks the submucous, muscular, and even peritoneal coats. In a few hours or in a day or two, depending on the intensity of the infection and the existing anatomical conditions in the appendix, it resolves. In the very mildest cases, such as are often spoken of as "appendicular colic," the process consists in either the attempt at the extrusion of a small fecal concretion or a simple catarrh with the accumulation of the mucus in the appendicular canal. Whether the concretions are present or not, the inflammatory process is, and it is the effort of the appendix to extrude this concretion and the contained exudate which gives in the early stage the symptoms of colic. I am fully aware that few cases have been found which tend to substantiate this view. If we examine carefully the cases reported by Bull, Binnie, Kammerer, and Von Hockstaetter, we can scarcely arrive at any other conclusion than that such symptoms as are ascribed to appendicitis when of very short duration can be produced by fecal concretions or mucus within the appendix. Can we make the differential diagnosis? Not

with certainty. Does it ever exist without evidence of inflammation? I can scarcely believe that it ever is present without some evidence of an inflammatory process, though this may be slight. The slightest forms of appendicular involvement belong to this class. Its characteristic is a sudden attack and general abdominal pain, which localizes in the right iliac fossa, with the point of greatest tenderness on the outer border of the rectus in a line between the umbilicus and anterior superior spine of the ilium ("McBurney's point"). Vomiting, with a temperature of 39° C. and an increased pulse, generally accompanies the above symptoms. The duration of this attack is from twenty-four to thirty-six hours. It passes away spontaneously or under an injection of morphine. The recovery is immediate and complete. The process is mainly a mechanical one. The average length of the appendix is sixteen times its breadth, and the amount of secreting surface is out of proportion to the lumen. Every excitation of the mucosa provokes an intense secretion within a short time, and places upon the muscular walls excessive demands for its extrusion into the cæcum. The swelling of the mucous membrane tends to diminish the lumen, and an increased obstruction is added to all the normal folds (Gerlach's valve). Abnormal folds the result of angular bends or twists, as well as strictures the result of former inflammation or evolution (Ribbert), will also aid this obstruction to the exit into the cæcum. We look upon the fecal concretion as an accident, an inspissation of fecal matter, dependent upon previous slight inflammatory processes, and in which the disease increases the concrement, and the pressure of the concrement renders worse the disease in the wall of the appendix.

A very common type of this variety consists in the following clinical history: The initial stage is sudden, and consists in the symptoms described above as appendicular colic. General abdominal pain, most marked about the umbilicus and in the epigastrium, together with an elevated temperature, 38° to 39° C., anorexia, slight vomiting, and general malaise are the initial symptoms. After about six hours or on the following day the pain localizes in the right iliac fossa, and tenderness is easily elicited at McBurney's point. The abdomen is tympanitic and slightly resistant over the appendix. The temperature remains between 38° and 39.5° The inflamed appendix may be felt in the right iliac fossa in many instances at this stage. The patient continues in this condition until the fourth, fifth, or sixth day, with a gradual diminution of his symptoms. At the end of seven, eight, or ten days nothing remains but the tender spot in the right iliac fossa. This tender spot disappears during the next week, or, if persistent, gives rise to another attack similar to the first or suppurative in character. The tumor when felt is elongated, sensitive, and corresponds in size to the little finger. Such an inflamed and distended appendix may undergo a more or less complete resolution or give rise to another attack with or without peritoneal complications. Several such attacks may succeed one another, in each of which the appendix is less liable to undergo resolution, owing to the gradual loss of its muscular power, to the increased involvement of its walls, and the angles and twists induced by the repeated adhesions.

Acute Appendicitis with Localized Adhesive Peritonitis.—In this variety we have an appendicitis, followed by peritonitis, which

is limited to the neighborhood of the appendix and is fibrinous in character, with a small amount of serous exudation between the appendix and the adjacent intestine. The symptoms correspond to those of an appendicitis followed by a plastic peritonitis.

The **symptoms** are similar to those of the former variety, but more rapidly and intensely marked. Especially is this the case with the rigidity of the right abdominal wall and the tenderness in the right iliac fossa. The characteristic symptom of this variety is, however, the tumefaction felt in the right iliac fossa without the appreciation of a distinct tumor. This tumefaction occurs in twenty-four to forty-eight hours after the attack, continues during the following forty-eight to seventy-two hours, and gradually diminishes until the tenth or fourteenth day, when resolution has advanced so far as to give but little evidence of peritonitis except upon deep pressure.

ACUTE SUPPURATIVE APPENDICITIS WITH LOCALIZED PURULENT PERITONITIS.—It still remains to be mentioned that in non-perforative appendicitis purulent peritonitis may be a complication. The appendicular lesion is that of a suppurative inflammation. The suppuration may include a greater portion of the tube or be confined to one or several small abscesses within the wall, which by sudden perforation or gradual extension give rise to a diffuse fibrino-purulent (ichorous), a progressive fibrino-purulent, or a circumscribed purulent peritonitis. These suppurative lesions are certainly more frequent than we believe.

Where a diffuse purulent peritonitis or a progressive peritonitis follows such an appendicitis, the **symptoms** are slower and less intensely developed than in gangrenous appendicitis. What more frequently happens, however—and one may consider it the rule—is a circumscribed purulent peritonitis as a complication of this variety. For the first twenty-four or forty-eight hours the symptoms are similar to those of an acute appendicitis. At this time, however, are added the signs of a localized peritonitis, which at first seems to be advancing toward the left half of the abdomen. During this time constipation is the rule. The fever is remittent between 38.5° and 39° or 40° C. The pulse is increased, but of good quality, and the patient shows the other evidences of suppuration. Chills are not only infrequent, but, as a rule, wanting. Whether the infection of the peritoneum has taken place by perforation in an encapsulated area or by a gradual extension, it is quite certain that twenty-four to forty-eight hours after its occurrence one or two teaspoonfuls of fetid pus may be found about the appendix. Such a tumor, owing to the rigidity of the abdomen, the site, and the meteorism, is often not appreciable until the fifth to the seventh day, although present from the third or the fourth day. If one is fortunate, an oval mass may be felt on the second or third day in the iliac fossa. The tumor does not depend on the swollen appendix, but upon the localized purulent peritonitis, which binds together the intestines and omentum and makes a tumefied mass of great extent, while the actual purulent collection is small. Depending upon the location of the purulent intraperitoneal collection, we may have, besides the symptoms of infection, pain in the districts supplied by the genito-crural, anterior crural, and obturator nerves, as well as vesical or rectal tenesmus.

The **complications** which have followed this condition when treated

expectantly are—(1) a diffuse purulent or progressive fibrino-purulent peritonitis, either as the result of a gradual extension or the sudden rupture of the purulent focus; (2) ulceration of the walls of the vessels, as the deep circumflex iliac, external iliac artery, internal iliac vein; (3) pylephlebitis; (4) retrocæcal or mesenteric suppurative lymphangitis or lymphadenitis; (5) spontaneous opening into cæcum, rectum, bladder, vagina, or externally. Of the spontaneous fistulæ, the external opening is the most frequent. The communication with the cæcum is next in frequency. The communication with the rectum or bladder, the extension to the thoracic cavity through the retrocæcal cellular tissue, and the ulceration of the arteries are next in frequency, but less common than the two first complications. Whether the external opening or that into the cæcum is the most frequent is still a question of statistics. Besides this intraperitoneal abscess, occasionally the suppurative process is thought to be primarily extraperitoneal. In exceptional instances, it is maintained by some, the appendix may be only partially surrounded by peritoneum throughout a greater portion of its extent, or it may be completely surrounded in one portion and not in another. If this is the case, a primary retroperitoneal cellulitis is the natural outcome. Many surgeons believe these cellulites are secondary to an intraperitoneal process. These paratyphlitic abscesses, whether they occur primarily in the retrocæcal tissue or secondarily from the peritoneum, show a certain typical course. They extend along the posterior wall of the ascending colon, surround the kidney, and reach the border of the liver. Advancing over the surface of the liver, they often give rise to extensive subphrenic abscesses or thoracic empyema and rupture into a bronchus. Such a retrocæcal abscess may break into the peritoneal cavity at any part of its extent. In other instances the abscess has advanced and appeared just above or below Poupart's ligament, has broken into the hip-joint or through the dorso-lumbar fascia, and then extended beneath the skin and fascia to the middle of the thigh. All such abscesses situated in the retrocæcal tissue should be minutely examined for the symptoms of an appendicitis followed by those of a retrocæcal tumor and septic infection.

The more marked the symptoms of this variety of appendicitis with intra- or extraperitoneal abscess the easier the **diagnosis**. When the primary attack is indistinct, slightly marked, or in recurrent cases where the course is insidious, it becomes one of the most difficult of diagnosis, and, consequently, the most dangerous to the patient. It is not uncommon to see these cases suffering two to three weeks with indefinite symptoms of suppuration, and without at any time having had distinct local evidences of an appendicular attack. Upon incision, however, more is found than was appreciated by an examination. The appendix is imbedded in a mass of adhesions sometimes communicating with the cæcum or a retrocæcal sac extending to the liver. Suppurative lymphangitis of the retroperitoneal cellular tissue, with or without mesenteric lymphangitis and lymphadenitis, as well as pylephlebitis and its results, are also met in just these cases. This variety is the most difficult to diagnosticate early, since the initial symptoms are not always sharply defined and the manifest symptoms are those of the complications mentioned. In our classification it is spoken of as a subacute variety.

CHRONIC APPENDICITIS.—This variety is characterized by the occurrence of distinct attacks with well-defined intervals. It may be divided into two forms:

I. Those where the attacks recur at long intervals, between which there is a period of apparent complete recovery;

II. Those cases where the disease is chronic, with successive attacks at short intervals.

The appendix is usually thickened and dilated. Its cavity is filled with mucus, which is thick, abundant, and sometimes mixed with pus. In some instances only the distal portion is dilated, owing to twists, flexures, or strictures the result of former attacks. The tension of the dilated wall is often marked, owing to the inability on the part of the appendix to extrude the mucus or muco-pus beyond the strictures, flexures, or twists into the cæcum. In a few instances small pus-foci have been found in the appendicular walls. There are frequently well-marked peritoneal adhesions present. In other cases the appendix is not dilated, but is converted into an irregular cord with thick walls and a small and irregular lumen. The adhesions surrounding it may be so abundant as to render its removal very difficult. In some instances recurrent appendicites have an additional lesion—namely, a small perforation with a periappendicular abscess in which may be found a fecal concretion.

The **symptomatology** of the recurrent appendicitis is the same as in the forms we have described. It may be a purely appendicular process, peritoneal or suppurative. These attacks have been thought to be due to an intermittent distention of the tube by mucus. Others have believed them due to the temporary obstruction by a small fecal concretion. Still others maintain that each attack is a fresh inflammatory process in the walls of the appendix or in the periappendicular adhesions. The first two forms are the more frequent.

The attacks are generally those of a simple appendicitis with appendicular colic or with adhesive peritonitis. The attacks of pain may be severe or only characterized by an obscure pain in the abdomen, followed by a fixed pain in the iliac fossa. Muscular resistance is present, and yields in three to four days, when one can feel the appendix, if favorably situated, as an oblong mass like the finger. This remains in the intervals of the attacks, diminishing in size and somewhat in sensitiveness. The attacks usually last eight to ten days. The peritoneal form differs only in the intensity of the local lesions, due to the intensity of the appendicular inflammation and the peritonitis. The suppurative form is quite infrequent, though by no means so uncommon as is generally thought. I have seen several such cases where in the recurrent attack, without a complete recrudescence of the local symptoms, the operation revealed a small abscess about the appendix and enlarged mesenteric glands. In the interval between attacks little discomfort may be felt, but after two, three, or four such attacks the recovery is not so complete, and local signs, such as vague abdominal pain, frequent attacks of colic, slight tympanitis, a feeling of uneasiness in the right iliac fossa brought about by physical fatigue, are frequently complained of. In the recurrent appendicitis the interval is never one of a complete recovery. In the relapsing variety this is apparently the case. The recurrent attacks offer a safeguard against perforation, or limit its result if it take place by means

of the adhesive peritonitis which accompanies it. The relapsing variety acts in each attack as a fresh appendicitis complicated by the results of the former attacks. While recurrent appendicitis has not the additional danger of perforation, in most instances it transforms the patient into a veritable invalid, incapable of work. The frequency of recurrent appendicitis is still somewhat doubtful. Krafft places it at 22 per cent.; Fitz places it at 11 per cent.

It is difficult to say, precisely, what is the severity of the appendicular attacks when taken as a whole. It is probably true that about one-half of the cases belong to the lighter forms—namely, the catarrhal, parietal, and the parietal complicated by a fibrinous peritonitis. When we consider, however, the various forms and their seriousness to the patient's life, we must place in the first rank the acute perforative appendicitis with a general peritonitis. This form is, except in unusually favorable conditions as to the time of operation, fatal in forty-eight to seventy-two hours, either from the abdominal shock, sepsis, or from a diffuse inflammation of the peritoneum. The next in point of gravity is the subacute variety. This is not the case because of the rapidity or severity of the infection, but in consequence of its insidious course, rendering the diagnosis often uncertain until its complications are manifest. To this variety belong the perforative appendicites with retrocæcal suppuration, mesenteric lymphomata, and pylephebitis, with and without abscess of the liver. The third place in point of severity is occupied by the perforative form, from either necrosis or suppuration with localized suppurative peritonitis. These cases show 52 per cent. of recoveries when treated expectantly, and when treated surgically 85 per cent. of recoveries. The fourth place is taken by the recurrent variety, which is generally not dangerous to life, but will render the patient unfit for work and constantly exposed to some of the more dangerous forms. In that variety called relapsing, with a long interval of quiescence, each attack must be placed under its own form and the dangers depend on the variety. The last place is occupied by the simple acute appendicitis, including catarrhal, parietal, and parietal with plastic peritonitis. These cases recover from the immediate attack, but may relapse or recur.

The question is often raised whether it is possible during the first twenty-four, forty-eight, or seventy-two hours to tell from the character of the symptoms if perforation will take place or not. It is, however, impossible to answer during this time, but on the third or fourth day one will find a partial or general peritonitis or its absence. If the latter is the case, then the appendicitis will remain in 50 per cent. of the cases—at the most, a simple parietal one. There are, however, cases where the signs of an acute peritonitis are wanting, and perforation and extension of the inflammation in the appendix involves a very limited area or extends into the retrocæcal cellular tissue. A careful examination of the iliac fossa will reveal, in most cases, an abnormal thickening to the outside or behind the cæcum and above the level of the anterior superior spine of the ilium. This local condition, with even obscure manifestation of a previous appendicitis, will be found to be derived from a retrocæcal cellulitis from subacute appendicitis. To avoid any error in the examination of the fossa it is necessary that the cæcum be empty. If peritoneal symptoms are present, the lesion will be either a general or a

partial peritonitis. If general, the patient will present the local and general signs of a peritoneal sepsis or a diffuse purulent (ichorous) peritonitis, the symptoms of which have been fully described. If at first a partial peritonitis exists, the symptoms will refer to a progressive fibrino-purulent, an adhesive, or a localized suppurative peritonitis. In the adhesive variety the local and general symptoms diminish steadily from the third or fourth to the eighth or tenth day, so that at that time the peritoneal symptoms are practically wanting, except for the slight pain remaining. If the abatement of the symptoms is irregular and incomplete, and the fever persists and assumes an intermittent or remittent type, with increasing malaise and anorexia, the condition is one of a localized suppurative or a progressive fibrino-purulent peritonitis. In case of the localized suppuration the local signs of a tumor in the iliac fossa are present, and no perceptible augmentation takes place. If the process is a progressive one, the increase in the size of the tumor and the advance of the peritonitis to the left of the abdomen or upward along the cæcum and in both directions is obtained by repeated careful examinations of the abdomen. In some cases, however, especially in the subacute variety, pus may be present without marked symptoms, either local or general, and we must rely upon an indefinitely defined induration in the neighborhood of the appendix with slight remittent temperature and septic cachexia. Of all the varieties, the subacute is the most difficult and uncertain of an early and accurate diagnosis.

In the early stage of every appendicitis where pain alone is the marked symptom a careful examination must exclude hepatic colic, renal colic, and acute indigestion. In hepatic colic the pain is present as an epigastric constriction: the cramps involve the region of the stomach. Vomiting is more frequent and is repeated. The pain radiates toward the shoulder or scapula; sensibility is extreme beneath the costal border. The fixed point of pain is at the level of the gall-bladder. In appendicitis the pain is more intestinal, sub- or periumbilical. Vomiting is occasional. The pain radiates toward the umbilicus. The fixed point of pain is in the right iliac fossa, generally at McBurney's point. In nephritic colic the pain radiates downward to the testicle or anus, accompanied by vesical or rectal tenesmus and retraction of the testicle. Oliguria is often present. Although appendicitis when favorably situated on the border of the pelvis may cause retraction of the testicle and painful micturition, its other signs are so manifest as to prevent this error. I have seen two such cases with painful micturition and retraction of the testicle, but in both cases the character of the pain, its radiations, and the fixed point of greatest intensity upon pressure allowed a differential diagnosis. In the acute indigestion the first effect is the pain, and often the vomiting. The vomiting is only an effort of the stomach to relieve itself, and has no diagnostic worth. The pain, however, is and remains diffuse, localizing itself, if at all, in the descending colon or sigmoid flexure. Under this condition we must think of the possibility of an appendix situated in the left hypochondrium, with its fixed point of pain there. Janeway has referred to the similarity which may exist between appendicitis with pain in the lumbar region (subacute variety) and lumbo-abdominal neuralgia. Gibney has made similar observations in reference to appendicitis and coxalgia.

Intestinal paresis occurring in the course of an appendicitis with general or progressive peritonitis has been not infrequently confounded with an internal strangulation of the intestines. The diagnosis is made by the examination of the abdomen. In an internal hernia or strangulation with obstruction, as well as in intestinal paresis following perforative appendicitis, the mode of onset is sudden, and in the case of obstruction more commonly without any definite preliminary symptoms. A rigor may usher in an acute peritonitis. This will not be the case in acute obstruction. In acute obstruction the temperature is usually low or subnormal, and remains so throughout the progress of the case. In acute peritonitis with intestinal paresis this may be the case, or the temperature may be elevated and remittent. In the peritonitis with intestinal paresis pain is severe and is attended with extreme tenderness, except in cases of peritoneal sepsis. In obstruction the pain is at first severe, but there is no marked tenderness. Meteorism may be localized at first in obstruction. It is diffused from the commencement in diffuse peritonitis. It is wanting in peritoneal sepsis. When intestinal obstruction exists in a case of appendicitis complicated by abscess or adhesions producing the obstruction, temperature is a valuable sign, since it does not occur in intestinal obstruction alone. Yet the main diagnostic value depends upon the diagnosis of an existing or preceding appendicitis, together with the evidence of simple obstruction.

With the subacute variety complicated with abscess, typhoid fever, tubercular enteritis, and peritonitis involving the cæcum and ilium, or actinomycosis, may be confounded if the symptoms of the appendicitis are not carefully looked after. To a careful diagnostician, however, this possibility will not occur after a complete history of the course of the disease and a careful examination of the abdomen has been made. With the tumor resulting from a subacute appendicitis cancer of the cæcum—*i. e.* ileo-cæcal valve—may be confounded. It is impossible in most cases, unless the case is well marked, to make the diagnosis positively without incision. With the appendix situated behind the cæcum, and a retrocæcal abscess complicating it, the diagnosis may be difficult to make from a pyonephrosis, perinephritic abscess, or an empyema of the gall-bladder. A careful examination and good history of the case will generally reveal the true state. When the tumor is situated below and to the inner side of the cæcum and hanging over the brim of the pelvis, pyosalpinx and pelvic hæmatocele have both led to an error in diagnosis. It should be kept in mind that during pregnancy perforative appendicitis has occurred. In some cases the perforation has taken place just after delivery. In other cases it has manifested itself during the last months of the pregnant state. The possibility of pregnancy after a severe appendicitis would alone justify the removal of the organ, since those cases occurring at this time have been most frequently perforative, with general peritoneal sepsis or a diffuse purulent peritonitis, and fatal in their results.

SURGICAL TREATMENT OF APPENDICITIS.

By CHARLES McBURNEY, M. D.

THE surgical treatment of appendicitis should be considered under two heads—first, palliative treatment; second operative or radical treatment.

Palliative treatment is to be applied to all cases of acute appendicitis in their incipient stage, excepting when they are characterized by such violent symptoms at the very onset that operation is immediately called for. Absolute rest in bed should be insisted upon, and either hot or cold applications be made over the right iliac fossa. As a rule, cold applications in the form of the ice-bag, or, better still, the cold rubber coil, are the most efficient in relieving pain and tending to diminish or restrain inflammatory action. Such hot applications as are capable of causing vesication and all skin-irritants, like blisters, iodine, etc., are to be avoided absolutely. They are entirely useless so far as restraining the disease is concerned, and they immediately put the integument in an unfavorable condition for operation should operation become necessary. The early nausea and vomiting which occur so frequently at the beginning of the disease are best treated by entire rest of the stomach. During the short period when vomiting lasts no food is necessary, and if stimulant seems required it may be given by the rectum. Troublesome vomiting is best treated by teaspoonful doses, frequently repeated, of very hot water and by the hypodermic injection of morphine in the dose of one-eighth or one-sixth of a grain. After a positive diagnosis has been made it is often desirable, and even necessary, to give a hypodermic injection of morphine for the relief of pain. But before the diagnosis has been made no morphine should be given, and even afterward it is very undesirable that enough anodyne should be administered to mask the symptoms, and so lead the attendant to underestimate the severity of the attack. Cathartics are not indicated at the beginning of an attack of appendicitis. Complete rest of the intestine, as of the whole individual, is called for, and cathartics only tend to increase vomiting and the general unrest of the patient. Moreover, the commencement of the larger intestine very rarely contains fecal accumulations at the beginning of the disease, and if an evacuation of the lower bowel is called for, it is best obtained by means of an enema. The use of antipyretics during the first days is to be deprecated, for these, like frequent doses of morphine, by lowering the temperature and so masking symptoms mislead the attendants. When nausea has subsided, milk, beef-juice, or any acceptable broth may be given in moderate quantity, and only gradually increased. No purely medical treatment of actual value

in preventing or controlling the disease has yet been presented to the profession.

An attack of appendicitis is not to be considered as finished until the bowel-function has become re-established and all symptoms have disappeared, excepting perhaps a little tenderness when deep pressure is made over the seat of the appendix. This last sign may exist for some time after the individual is in other respects entirely restored to health.

The operative or radical treatment of appendicitis must vary much according to the nature of the case, but it is not to be assumed that every case which is not very mild, and which does not begin to subside at an early period, will be subjected to operation. Whatever may be the views of the attending surgeon, the question in regard to operation will frequently be answered in the negative. Certain contraindications may exist, such as coincident disease of a grave nature, or extreme obesity such as to render an operation too difficult or hazardous; the patient or the patient's friends may refuse consent; and, lastly, the surroundings of the patient, the total lack of experience on the part of the attending surgeon, or the absence of proper assistance may render operation very inadvisable. The operation in any case may be exceedingly difficult, and should not be undertaken in the face of any removable difficulties.

It is unnecessary to mention here, in detail, all of the precautions which should be taken to ensure the greatest safety, for they are such as should be taken in every important surgical operation. It is enough to say that every effort should be made to avoid the introduction of sepsis, whether pus exists about the appendix or not.

Any good table, properly covered, is satisfactory. The patient should lie upon his back in a good light. In the opinion of the writer, no advantage is to be derived in this operation from the Trendelenburg position. A good assistant is of the utmost importance, for his fingers will be of far more use in holding intestinal coils out of the way than the most carefully placed retractors and packings. After the patient is completely anæsthetized and the abdominal muscles are entirely relaxed, a careful examination by palpation should be made of the region of the appendix. When the muscles are quite flaccid it is not unfrequently possible to make out a thickened, enlarged appendix and to locate its position accurately. At this time, too, tumor can frequently be detected which previously had escaped recognition.

The probable amount of intra-abdominal dissection that will be required will influence one in the selection of the method of operation, and this will often be determined, even in cases where pus is quite positively absent, by the history of the case, as the extent and severity of the inflammatory action in previous attacks usually determine the extent and density of adhesions. The presence or absence of tumor is also of importance, for when tumor continues to exist throughout the interval of freedom from all acute signs the intra-abdominal dissection is often difficult and necessitates free incision. The incision of the abdominal wall should be so made as to permit ready access to the base of the appendix,[1] as this is the only part of the organ that is at all uni-

[1] In cases presenting large or unusually-placed abscess the position of the incision may differ much from that ordinarily employed.

formly placed, and from this point often must the intra-abdominal dissection begin. All surgeons are of one mind in this, that the incision should be made to the right of the edge of the rectus muscle; that is, at some point, varying in different cases, between the rectus muscle on the inside and the outer part of Poupart's ligament on the outside.

In describing the operative treatment of cases of appendicitis it will be most convenient to first consider those cases which most nearly approach the normal condition—namely, cases of recurrent, relapsing, and chronic disease. No one method of operation is suitable for all cases, for they vary much in the extent of operative work required and in the difficulties encountered. In some cases it is perfectly evident, from the previous history of the case, that the operation required will be nearly such as would be proper if one were called on to remove a normal appendix. In others the history and the physical examination of the patient render it quite certain that to complete the operation a quite extensive and difficult intra-abdominal dissection should be anticipated.

The indications for operation in cases of recurrent appendicitis must vary much in different cases, according to the severity of the attacks, the loss of time, and the disability which they have occasioned, the presence or absence of contraindications to operation, and also according to the ability of the operator to perform a perfect operation amid suitable surroundings. Supposing that no contraindications, such as coexistent important disease or other obstacle to safe operation, such as very great obesity, are present, operation should be fairly considered in every well-defined case. While one would hesitate to advise operation in the case of an individual who had had but one very mild attack, yet even the most conservative practitioner of experience will acknowledge that the future of that individual is uncertain. Still, in such a case most surgeons would advise delay to determine whether a second attack would occur. It by no means always does occur. If only *one* attack has been noted, but if that attack has been very clearly defined with active symptoms, and more especially if, after the attack, well-pronounced tumor or abnormally enlarged tender appendix can be felt, operation should be done without waiting for recurrence. A great many lives have been lost by delay under such circumstances. If several attacks have occurred, and particularly if they have been of increasing severity, operation offers the only reasonable hope of safety and a return to complete health. When one considers the very small mortality accompanying the operation done during the period of quiescence—not more than 1 or 2 per cent. in the hands of good operators, even when the operations include many difficult and unfavorable cases—one may well hesitate to advise delay in applying the only remedy that can cure. The small risk from the operation is to be contrasted with the uncertainty of life, the loss of time, the disability, the impairment of general health, and the constant dread which exists in most cases of recurring appendicitis. It should not be forgotten, too, that the most favorable time for operation is during the interval between attacks, and that a recurrence may urgently demand operation to save life at a time when a less perfect operation can be done and when the risk to life is greater.

The patient should be prepared for operation by securing thorough

evacuation of the bowels on the day before. On the morning of operation a large enema should be administered. The whole abdominal wall should be thoroughly sterilized.

A free skin-incision is very desirable. The incision should begin about one inch above a line drawn from the anterior superior spinous process of the ilium to the umbilicus, and may be so placed as to correspond with a line drawn parallel to and about half an inch to the right of the edge of the rectus muscle; or, starting at the same level, it may lie farther outward, and be drawn obliquely so as to cross at right angles the line drawn from the anterior spine to the umbilicus at a point from one and a half to two inches internal to the spinous process. The external oblique aponeurosis should be clearly exposed and its fibres separated with knife or scissors without cutting any of them transversely. If the first incision has been chosen, that near the rectus muscle, the tendinous termination of the internal oblique will be uncovered when the edges of the incision in the external oblique are separated. This tendinous layer is to be divided through a distance of about two inches, and at the same time the tendon of the transversalis muscle is divided as well. It is very desirable to avoid opening the sheath of the rectus muscle, as doing so always interferes with subsequent neat apposition of the edges of the wound, and is frequently accompanied by unnecessary bleeding from wounded twigs of the deep epigastric artery. For this reason it is better to place the incision just *external* to the commencement of the tendinous fibres. A few muscular fibres will be thus divided, though most of the section will pass through tendon only. The sheath of the rectus muscle will then be safely avoided, and the tissues composing the edges of the wound will not separate from one another, and will be readily handled when the wound is to be sutured.

If the second incision, that lying farther outward, has been chosen, then the separation of the fibres of the external oblique will expose the muscular surface of the internal oblique most readily. The deeper incision will pass directly through the muscular fibres of the internal oblique and transversalis; and here, again, the deeper incision need not, at first, be more than two inches in length. The tissue now exposed is the fascia transversalis, which should be incised in the same manner, exposing the fatty layer between the fascia and the peritoneum. The fatty layer may readily be pulled apart with forceps or cut with scissors. All bleeding vessels should now be ligated, all artery clamps removed, and the wound and surrounding area be thoroughly cleansed, preferably with normal salt solution. The wound being dry and clean and the hands washed freshly, the peritoneum should be opened, care being taken that no underlying adherent portion of intestine or omentum is wounded. Through the limited wound now made the fore finger is to be introduced and search made for the appendix. Not infrequently it will be at once found, and when free from adhesions will be readily turned out through the wound, so that the rest of the work may be made practically extraperitoneal. In other cases it will be readily discovered that the appendix is firmly adherent or much misplaced, in which event it will often be best to now further enlarge the abdominal wound to three inches or more in length, to permit of safe and speedy dissection. In other cases the finger will fail to find the appendix,

and search must be made in a more systematic manner. The most certain method is the following: First find the ascending colon, readily recognized by its longitudinal muscular bands. Tracing the colon downward, the anterior of these bands leads directly to the base of the appendix. In pursuing the search it may be convenient to draw out a portion of the colon, which again should be replaced when the base of the appendix is detected.[1]

If the appendix is firmly adherent, it should never be blindly torn out with the finger. The adhesions sometimes bleed sharply, and the appendix may be closely attached to, even communicate with, a coil of intestine. At this stage the fingers of a good assistant are invaluable in holding back obtrusive portions of omentum and coils of small intestine. A sponge or gauze pad held in the jaws of a sponge-holder is often better than a finger for this purpose. If the tip of the appendix can be readily reached, it is well to begin the separation of adhesions and the tying off of the mesentery of the appendix at this point, and so work toward the base. Adhesions can generally be broken down by blunt dissection, but if vascular they should be tied with fine catgut. If the appendix is adherent to a coil of intestine, great care should be taken, and in some cases it is wiser to leave a thin layer of the outer coat of the appendix attached to the intestine than to run the risk of damaging the gut. When the appendix is closely attached to intestine, the point of attachment may cover a communication between the two, and such communication is necessarily opened when the separation is made, and the intestinal wound requires suture. If the mesentery of the appendix is narrow, it may be tied off with a single catgut ligature passed with the aneurysm needle near the base of the appendix. If the mesentery is wide, it is better to tie it off in sections, the ligatures being applied far enough away from the appendix to avoid their slipping when the appendix is cut away. The dissection is thus made from the apex to the base until nothing remains but the attachment to the colon. In many cases, however, the distal end of the appendix is deeply and strongly adherent, and even its whole length may be densely covered by adhesions. In such cases it is best to first detach the base of the organ from the colon, disposing of the proximal orifice at once, and then from base to apex making the dissection, the colon being now pushed out of the way and the mesentery and adhesions being dealt with by blunt dissection, scissors, and ligatures, as may be called for. The appendix should usually be cut at a point about a quarter of an inch distant from the colon. It should *not* be ligated at first between the point of section and the colon, for the reason that a stricture, even completely impervious, may exist between the section and the cavity of the colon.[2]

If this condition exists and a ligature is applied beyond the stricture, the operator will reproduce the conditions liable to induce a fresh attack. After the section is made a probe should always be passed through the base of the appendix into the colon to determine that natural drainage for the stump will exist. If the canal is not pervious,

[1] The appendix is always to be found in recurrent or relapsing cases if sufficiently careful search is made. It is never "absorbed" in these cases, although in delayed acute cases it is often entirely destroyed by an active suppurating process. But the finger alone, unaided by the eye and proper incision, may fail to find it.

[2] The writer has met with several such instances.

the interior up to the point of stricture should be dissected out or cauterized before suture or ligature is applied.

The methods of disposing of the stump are various. The peritoneal coat of the stump may be pulled over the middle and inner coats and carefully sutured with fine silk or catgut, or the mucous membrane of the stump may be cut out and the middle and outer coats sutured. If the stump is not too rigid and is sufficiently patent, it may be depressed into the wall of the colon, and the rim of peritoneum at the base of the point of inversion may be sutured by a double row. The stump may also be cut away very close to the colon, and that portion of the wall of the colon which includes the orifice be depressed with a probe, and the edges of the furrow thus made sutured with a double row of fine catgut or silk.

The writer has frequently used the following plan: The appendix having been cut away, as usual, the edge of the stump is held with a forceps. The permeability of the short canal is tested with a probe. The fine point of the Paquelin cautery is then pushed in so as to destroy the mucous membrane nearly to the colon. A fine catgut ligature is tied about the stump *within the cauterized area*. The button of the stump beyond the ligature is then reduced with scissors to very small proportions, and its surface freshly cauterized. This method has proved simple and efficient in a large number of cases. The author feels justified in highly recommending it.

A very neat and perfect method of closing the stump has been recently suggested by Dr. Robert Dawbarn. A continuous purse-string suture of silk passing through the superficial layers of the cæcum, one-fourth of an inch distant from the base of the appendix, is first placed, but not tied. The appendix is cut away, leaving a stump about half an inch long. The canal of this stump is stretched with fine forceps, and the stump then invaginated into the intestine. The purse-string suture is then tied, the forceps used for invagination being withdrawn at the moment of tying. Nothing could be better than this for cases in which the method is feasible. Of course when the stump is very rigid or much diseased invagination may be impracticable, and some simple form of suture, after cutting away diseased tissue, must be resorted to; but the reader is warned that when the stump is thick and stiff or the calibre very narrow there is danger that by this method the diseased stump may be not inverted at all, but merely depressed into the wall of the colon. In this case drainage of the septic stump into the colon might fail to go on.

All portions of intestine that have been exposed or handled, and the whole wound-area, should be thoroughly washed with hot sterile salt solution, and all bleeding points carefully attended to with ligature or cautery. The peritoneal wound, and also the wound in the fascia transversalis, are to be sutured closely with catgut. The muscular or tendinous wound in the abdominal wall is also to be separately sutured, every effort being made to obtain close apposition, and so avoid the tendency to subsequent hernia. The aponeurosis of the external oblique may be rapidly closed with a continuous catgut suture. If the work has been done with proper regard to asepsis, the whole wound should be closed and no drainage made. Occasionally, however, a patient giving only the

usual history of recurrent appendicitis will be found at operation to have a septic focus in the form of an encysted abscess or encapsuled granulation-tissue. In such cases a strip of gauze or other drainage should for safety be brought out through the wound. The skin-wound is closed in the usual manner. The author inserts at each end of the skin-wound a small strip of thin gutta-percha to drain the subcutaneous spaces only. This is removed at the first dressing and never leaves a sinus.

The first change of dressings may be made at the end of twenty-four or forty-eight hours as is most convenient, and any superficial drainage, such as has been just referred to, removed. Sutures, if of silk, should be removed on the seventh or eighth day, or earlier if causing irritation. If the wound has required deep drainage with gauze from the time of operation, such drainage material should be removed on the second or third day, and replaced or not according to the condition of the wound. Very complete repair should have taken place in any wound involving the whole thickness of the abdominal wall before the patient should be allowed to rise or even to sit. Certainly in all cases where the muscular or tendinous wall has been divided by section of the fibres at right angles to their course recumbency for three weeks should be maintained. This care is required in order to diminish as much as possible any tendency to weakness of the scar-tissue and subsequent hernia.

Incision of the abdominal wall in two different lines has been described, and it will be remembered that in one of them the tendinous termination of the internal oblique and transversalis muscles was divided, the section crossing the course of the fibres at right angles. In the second incision the muscular fibres of the internal oblique and transversalis are divided at nearly a right angle. These incisions divide also the nerves which cross the line of section to supply the abdominal muscles, and more especially the rectus muscle. Partial muscular paralysis of this portion of the abdomen is necessarily produced. The oblique incision, which lies nearer to the anterior spine of the ilium, is more difficult, and is accompanied by more bleeding, than the one which lies close beside the edge of the rectus muscle, but it is better suited to the intraperitoneal work required in many cases. When the appendix lies to the outside of the colon, pointing upward, or when it passes from without inward behind the colon or downward close to Poupart's ligament, it is most readily reached and followed to its termination, if adherent, when approached from without. To avoid the damage to the abdominal wall which is caused by either of the incisions which have been described, and to allow of more perfect replacement of the parts disturbed, the writer devised the following operation: A skin-incision about three inches long is made, beginning at a point one inch above the line drawn from the anterior iliac spinous process to the umbilicus, passing obliquely downward, crossing that line at a point one and a half inches internal to the spinous process, and corresponding as accurately as possible in direction to that of the fibres of the external oblique muscle and aponeurosis. The section of the external oblique should really be a separation of the fibres of this structure in a line corresponding to the skin-incision, great care being taken *not to cut any fibres across.*

When the edges of the wound in the external oblique are now

pulled apart with retractors, a considerable expanse of the internal oblique muscle is seen, the fibres of which cross somewhat obliquely the opening formed by these retractors. With a blunt instrument, such as the handle of a knife or closed scissors, the fibres of the internal oblique and transversalis muscles can now be *separated*, without cutting more than an occasional fibre, in a line parallel with their course —that is, nearly at right angles to the incision in the external oblique aponeurosis. Blunt retractors should now be introduced into this interval and the edges separated. The fascia transversalis is thus well exposed and is then divided in the same line. Last of all, the section of the peritoneum is made.

Two sets of retractors must be in use, one holding open the superficial wound from side to side, the other separating the edges of the deeper wound from above downward. A considerable opening is thus formed, through which, in suitable cases, the caput coli can be easily handled and the appendix removed. The appendix having been taken away, the wound in the peritoneum, which is transverse, is then closed by suture; the similar wound in the fascia transversalis is also sutured. The fibres of the internal oblique and transversalis muscles fall together as soon as the retractors are withdrawn, and with a couple of fine catgut stitches the closure can be made more complete. The wound in the external oblique aponeurosis is sewed with catgut from end to end. When the operation is completed it will be seen that the gridiron-like arrangement of the muscular and tendinous fibres to which the abdominal wall largely owes its strength is restored almost as completely as if no operation had been done.

In performing this operation I have noticed several advantages: In the first place, muscular and tendinous fibres are separated, but not divided, so that muscular action cannot tend to draw the edges of the wound apart, but rather to actively approximate them. Excepting during the incision of the skin almost no bleeding occurs. The fascia transversalis not being drawn away by the retraction of the deepest layer of muscular fibres, this fascia is easily completely sutured, and thus greater strength of repair is assured. No muscular fibres or larger nerves having been divided, pain after operation is almost absent. The operation requires rather more time than the usual one, and a larger number of assistants is needed, for four retractors are in use during part of the time. The opening into the peritoneal cavity is not large, but may be made larger if necessary by continuing the separation of the fibres of the internal oblique and transversalis, and dividing the conjoined tendon with scissors. In the opposite direction the separation of the muscular fibres may be carried as far as the anterior spine of the ilium.

The operation just described has been applied by the writer to a large number of cases with most satisfactory results. After healing has taken place the abdominal wall seems to be as strong as though no operation had been done. This operation is *not* recommended for use in *suppurative cases*, for the safe treatment of which more or less extensive drainage is required. Its proper application is for cases that are in such condition that complete closing of the wound is permissible.

The operative treatment of cases of acute disease during the inflam-

matory condition is now to be considered. In all such cases the reason for operating is the belief on the part of the surgeon that positive infection of the tissues has begun, and that septic material, if not already present outside of the appendix, threatens soon to occupy that position. The signs of progressive acute disease vary very widely in different cases, and no single method of procedure is applicable to all cases, even when the operation is done at what is apparently the same stage. High temperature, quick pulse, great pain, and well-marked muscular rapidity may all be noted, and yet the inflammatory process be entirely confined for the present to the appendix itself. In another case only one or two of these symptoms may be present, and yet a considerable area of peritoneum be already involved and purulent exudation be already abundant. The important element, progressing infection of the tissues, is present in all acute cases which demand operation, and the method employed and the preparations made should cover the possibilities in any given case.

Not all cases of acute appendicitis by any means demand immediate operation. This is evident when we consider the large number of patients who give a clear history of having had numerous acute attacks, from each of which they have apparently recovered. Nevertheless, every acute attack deserves the closest observation. In some it is clear, within the first few hours, that an operation cannot be done too soon. This is evident from the severity and rapid increase of the symptoms and from the clearly-defined serious illness of the patient. When pulse and temperature are both high, when vomiting is persistent, and the signs of a rapid involvement of peritoneum are present, operation should be done at once. Other cases which also demand very early interference are those in which, though both pulse and temperature may be low, the patient's general appearance and behavior indicate the existence of early general sepsis. Delay in such cases even for a day may readily permit of the establishment of a septic condition from which there is no recall. An abnormally sallow coloring, a general sense of weakness, a feeble pulse, rather ill-defined pain in the usual locality, with a widespread tenderness on pressure, especially over the pelvis, are indications of a septic condition of gravity. When such signs are present, gangrene of the appendix is often found, or a suppurative condition without limiting adhesions, septic fluid rapidly accumulating in the pelvis.

The more usual type of acute appendicitis is that characterized by sharply-defined symptoms, as has already been described in the section on Symptomatology. These cases deserve close and frequent observation. If by the end of thirty-six hours from the beginning of the attack there are no well-marked signs of abatement of the disease, operation is usually indicated. Operation at this stage is radical, and can be made very safe, and the wound-healing is excellent. If no operation is done, the patient will either temporarily recover with the strong probability of a recurrence of the disease, or an abscess will form which will be opened after a more or less dangerous illness, or some accident such as the rupture of an abscess will occur and the patient will almost certainly die.

If at the end of the same period, about thirty-six hours, there is a doubtful condition and it cannot be decided whether the patient is get-

ting better or not, it is safer to operate than to delay. No greater mistake can be made than to wait for very clearly-defined signs of advanced and grave disease before deciding to operate. Operation, to be usually successful, must be done before grave disease is well pronounced.

If at the end of one or two days it is clear that the attack is a mild one, and will be rapidly recovered from, operation may with great advantage be postponed until all signs of illness have entirely disappeared.[1]

According to the judgment of the surgeon and the wish of the patient such a case will then be operated upon in the quiescent period before another attack occurs, or the policy of awaiting the arrival of another attack will be adopted.

The incision in the abdominal wall should be so arranged as to permit of the removal of the appendix, the cleansing of the surrounding tissues, and the subsequent treatment of the involved area with the greatest completeness and safety. A median incision is therefore excluded. After the patient is fully anæsthetized and muscular rigidity and pain are entirely absent, valuable information may often be gained by palpation in regard to the exact situation of the appendix or previously unsuspected tumor. The operator might then be led in one case to prolong his incision more especially toward the pelvis, or in another case more especially upward in the loin. Of the two lines of incision, the vertical one placed just to the right of the edge of the rectus muscle, and the oblique one lying nearer to the anterior spinous process of the ileum and Poupart's ligament, the latter is often to be preferred in acute suppurating cases. In the majority of instances the base of the appendix will be most readily found and the organ most easily and safely traced to its termination when approached from the outer side. From this direction also can septic fluids be most safely removed and drainage be subsequently most readily maintained. Moreover, when continuous drainage through a large open wound is required for some time, there is less liability to hernia if the wound lies quite at the edge of the abdominal cavity than if placed nearer the median line.

In considering operation it is convenient to divide acute cases into two classes: First, those in which it is evident or probable before operation is begun that the free peritoneal cavity must be deliberately opened as soon as the abdominal wall is incised; and, secondly, those in which abscess-formation so approaches and involves the anterior wall of the abdomen that the abscess may be opened without invading the non-infected portions of the general cavity. To the first class belong, at the present day, the very large majority of acute cases operated upon within the first few days of the disease. To the second class belong those rather rapidly-forming and older abscess-cases in which the abscess tends to approach the outer and anterior wall of the abdomen.

It is a good general rule, when operating upon one of the first class

[1] It is not best to operate immediately after an acute attack of even moderate severity, for the reason that it often requires some little time for all infection to disappear from the tissues about the appendix. The best operation can be done at a time when the peritoneum and connective tissue are so free from infection that a perfectly clean operation is possible, and the entire wound may be closed without drainage. Probably two weeks or more should be allowed to elapse after an acute attack before operation is attempted, the patient in the mean time taking every care to avoid a relapse.

just referred to, to so plan the operation that the base of the appendix may be reached and identified, no matter where the tumor, if there is one, is situated. If one can identify the base of the appendix, the problem, often difficult, of unfolding the complex inflammatory tumor can frequently be readily solved.

Incision should be made much in the same manner as has been already described in connection with cases of recurrent appendicitis. Beginning at a point about an inch higher than the anterior spinous process of the ileum and one and a half inches internal to that process, the skin should be incised for about four inches obliquely downward, the direction corresponding to that of the fibres of the external oblique aponeurosis. The fibres of this aponeurosis should be separated, without cutting, throughout the whole length of the incision, and the edges of this cut held open with retractors. If œdema of the connective tissue is here noted, it is an indication that the inflammatory process is sharp and that pus will be found very near the anterior wall of the abdomen. The internal oblique and transversalis muscles are now to be cut with the knife in the same direction—that is, nearly at right angles to the course of their fibres. This deep incision should be at least three inches long in order to allow of easy access to the peritoneal cavity. Cutting through these fibres completely, first at the centre of the incision, the transversalis fascia will be recognized as a white membrane immediately beneath the deepest muscular fibres. The incision should be completed either with knife or scissors until the fascia transversalis is recognized throughout. This fascia may then be divided in a similar manner without cutting the peritoneum. All bleeding points should now be ligated and all artery-clamps and retractors removed. The wound should be cleansed and the surrounding abdominal wall as well, and the peritoneum is now to be opened, first lifting it with forceps to be sure that no adhesion to a portion of intestine exists. The peritoneum is to be cut as was the fascia transversalis for at least three inches. If at the point where the first attempt to open the peritoneum is made adhesions are found, it is safer to make the opening at another point. The finger should be introduced before the entire peritoneal cut is made, so as to protect adherent intestine or omentum against scissors or knife. Small sponges on holders should be held ready at this time to absorb any fluid which may appear. The location of the appendix, if it is not at once seen, can now be usually determined by the finger, for in acute cases some thickening, or even well-marked inflammatory tumor, will be appreciated. The first assistant can now with his fingers, aided if necessary by sponge or gauze pad, draw loose intestines and the inner edge of the wound toward the median line. This will allow the operator to more accurately examine the region affected. Adhesions, at this stage usually soft, are to be gently broken down with the finger until the appendix itself or the close approach to a pus-collection is appreciated. Before an abscess-cavity, if one exists, is opened, and indeed in almost all cases, it is well to adopt the same precaution; one sponge or gauze pad should be placed just below the lower end of the wound and within the peritoneal cavity to protect the pelvis from infection, and a second should be put just above the upper end of the wound. In this manner a shut-off space is formed in which the most of the work may be safely

done. Separation of the appendix may now be continued with the finger until it is entirely free, and if no perforation has occurred and no pus-collection is formed, the remainder of the work is easy. The mesentery should be tied off with catgut, either with a single ligature or in sections according to its width, and the appendix cut free with scissors until it remains attached to the colon only by its base. This portion is very frequently nearly healthy or at least quite firm, and should be divided about one-quarter of an inch from the large intestine. The permeability of the short stump should be tested with a probe, and if pervious it may be tied quite close to the intestine with catgut. The writer prefers to cauterize the interior of the stump with the Paquelin cautery before applying the ligature. Or, the ligature having been applied, the interior of the stump down to the ligature may be cauterized with carbolic acid or nitric acid on the end of a probe. The stump is, however, in acute cases, frequently thick and hard, or partially invaded by gangrene, or entirely necrotic, and under such circumstances it must be handled gently and of necessity apparently imperfectly. It is very desirable to remove all necrotic tissue, and if the orifice left is irregular and imperfect, it should be inverted and over-stitched. If at any stage in the work after the peritoneal cavity has been opened it is evident that an abscess exists, careful inspection should be made to determine the most feasible or convenient point to enter it. When this is decided, sponges or gauze pads should always be so placed as to wall off the non-involved adjacent regions of the peritoneal cavity. A channel opening at the wound is thus formed, through which pus can safely be evacuated. Breaking down adhesions, a very small opening should be made in the wall of the abscess. As a little pus escapes, it should be quickly absorbed with a small sponge on a handle until the quantity of pus is much reduced. The opening may then be enlarged until all fluids are removed, and the entrance to the cavity is as free as it is possible or safe to make it.

Up to this time the appendix may not have been seen at all, or it may be found quite free in the abscess-cavity and be readily removed. Or it may be so closely identified with a part of the wall of the abscess that to remove it would be to incur the grave risk of infecting fresh tissues beyond it. The appendix may in some cases even escape detection at all. It must depend upon the judgment of the operator whether in such instances as the last two referred to it is best to insist on the removal of the appendix or its remnant at any risk, no matter how difficult and prolonged the dissection, or to leave it and trust to the reparative work in the wound-healing to render it harmless by obliteration. In some cases it is undoubtedly safer and wiser to leave the appendix rather than to insist on a dangerous and prolonged dissection.

It is true that in some few cases that portion of the appendix which is thus left in the wound will subsequently give rise to renewed attack or induce a chronic fistula. But the first consideration is the life of the patient, and if a first attack occurs or a fistula remains, a second operation can be deliberately done at a favorable time for the removal of the cause.

In handling such abscess-cavities, and in the management of the wound in general in acute cases, the writer advises against irrigations,

and particularly against the use of antiseptic fluids, such as bichloride solutions. The wounds and cavities can be quite satisfactorily cleansed with small sponges, and the best fluid to use for very gentle washing and mopping is the hot sterile salt solution. Much better results are attained in this manner than by vigorous irrigations. The whole wound—including abscess-cavity if it exists—and the neighborhood of the stump of the appendix having been gently and thoroughly cleansed and dried out, the dressing is to be applied. The wound and abscess-cavity should be well filled, but not stuffed to distention, with iodoform gauze. All parts of the wound which have been infected should be subjected to gauze drainage. Close suture of part of the wound is permissible in some cases.

Tube-drainage is of little or no value in most cases, although of course there are exceptional instances where the entrance to an abscess-cavity is so small or the depth and extent of the cavity so great that one is in doubt as to the completeness with which the gauze has been introduced. In such instances a well-placed tube gives additional security against a deep collection of fluid. In many cases when the operation is finished it will be noted that a considerable part of the exposed deep wound-area has not been infected at all or even soiled. In such cases there is an advantage in leaving that portion, after proper cleansing, unpacked with gauze, and closing with carefully applied stitches, the corresponding part of the abdominal wound. Just how much primary closing of the wound will be safe must depend on the experience and judgment of the operator. It is certainly true that the life of the patient who has been operated on for acute appendicitis, with more or less infection of the adjacent peritoneum, is safer when the wound is left open and abundant gauze drainage is made use of than it is when drainage is limited and the wound too much closed.

The outside dressing should be abundant, and is most perfect when made of sterile gauze. Over this should be placed a soft cushion of sterile cotton, and, enclosing the whole abdomen, a firm binder or bandage. After operation a hypodermic injection containing one-sixth of a grain of morphine and one-two-hundredth of a grain of atropine will add to the patient's comfort. A stimulating enema containing one ounce of whiskey or brandy should be administered, and nothing should be given by the mouth for twelve hours, unless it be an occasional teaspoonful of hot water to allay thirst or nausea. After this time light fluid nourishment should be given for two days, when solid food may gradually be permitted. Often within forty-eight hours after operation inability to expel will cause painful accumulation of gas in the intestine. This condition is most readily relieved by a simple soap-and-hot-water enema. The outer dressings should be changed on the day following operation, for the serous drainage into the sterile gauze is often abundant. The deep packings in the wound are to be removed at the end of the second or on the third day. This is quite painful, but with a little patience the packings can always be loosened and taken out. Sometimes, with an unmanageable child, it is necessary to give a little chloroform in order to make a change of dressings properly. The wound is now to be gently mopped out and cleansed with slightly moistened pledgets of cotton or with sterile gauze, and is to be again repacked, this

time considerably less iodoform gauze being introduced. A similar change of dressings should be made every second or third day, the quantity of packing rapidly growing less as the wound closes from the bottom. When the wound is so far healed that nothing is left but an uncomplicated fissure without sinuses rapid closure may be attained by curetting or cutting with scissors the granulating tissue and suturing the edges closely together.

The method first described applies to the management of an average case in which the extension of infection is not great and is confined to the normal situation of the appendix and its immediate neighborhood. Not infrequently considerable variations in one or more details of the method must be made in order to meet the peculiarities of the case. The writer has often made the remark, and has heard others make it, that no two cases of appendicitis are alike in all particulars. The organ may pass upward along the outer side of the colon, even reaching to the kidney or liver, and so its dissection or the cleansing of an abscess-cavity may require an extensive prolongation of the incision upward; or it may extend downward and reach as far as the bladder or to the opposite side of the peritoneal cavity, so as to render the completion of the operation exceedingly difficult. The writer has, however, never yet found it necessary or advisable in any case, excepting some of diffuse peritonitis, to make other incision than the right lateral one.

The second class of cases, those in which abscess-formation so approaches and involves the anterior wall of the abdomen that the abscess may be opened without invading the non-infected peritoneal cavity, deserves a separate consideration. Such were the cases subjected to operation by Willard Parker, and which, before his operation was suggested, ended, after long illness, by rupture into the peritoneal cavity, evacuation through the intestine, spontaneous opening through the abdominal wall or, after deep burrowing, at some point in the thigh or through the diaphragm. General sepsis, ending fatally, was also frequent.

The tumor in these instances is generally a week or more old, and usually lies close to the outer half of Poupart's ligament. Occasionally the tumor approaches the anterior wall of the abdomen, above and behind the anterior spinous process of the ilium, or nearer the median line and away from Poupart's ligament, or quite in the hypogastric region above the bladder. The outline of the tumor can usually be easily defined by palpation, but is not always dull on percussion, as gas produced by decomposition may occupy the highest point of the pus-cavity. After anæsthesia is complete palpation will generally satisfy the operator that at some point the contents of the tumor are not separated from the anterior wall of the abdomen by intestine. The incision in such cases should be made cautiously as near the external edge of the peritoneal cavity as is possible when the tumor is situated laterally, and as near the centre of the tumor as is possible when the mass is situated elsewhere. In the majority of instances the incision will lie very near to and parallel with the outer half or two-thirds of Poupart's ligament. The incision of skin and of external oblique aponeurosis should be from three to four inches long.

The deeper muscles are often infiltrated with inflammatory products,

so as to render their definition difficult. If such infiltration is very marked, the certainty of pus being close beneath is complete. If the muscles are quite unchanged in consistency and coloring, it is likely that a mistake has been made, and that the general peritoneal cavity must be opened before the exact position of the abscess can be ascertained. Carefully cutting through the altered deep muscles, the fascia transversalis will sometimes be recognized or the fluctuation of fluid beneath it. If the indication is perfectly clear, the point of the knife may be used to make a small opening and demonstrate the existence of the pus-cavity. If doubt is felt, it is safer to use a blunt instrument like a director or the closed scissors, and so gradually scrape through the abscess-wall. One should not forget that an unsuspected coil of intestine may be adherent at any point. A small opening having been made, a portion of the abscess-contents may be allowed to escape when, the entrance being cautiously enlarged by stretching rather than cutting, the finger should be introduced. It is then at once easily ascertained whether intestine is adherent at a near point or whether the opening may safely be cut with the knife to the full size of the external incision. It is very desirable in these cases to establish at the time of operation a large entrance to the cavity, not only that the contents may be completely evacuated, but that subsequent treatment may be facilitated. Careful search should be made with the finger for fecal concretions or foreign bodies, as the neglect to find and remove such may lead to inveterate sinus. The appendix may have entirely separated and escaped with the fluid as a soft slough, or the larger portion of it may be still alive and firmly attached. The cavity should now be gently sponged out and very gently irrigated, preferably with hot salt solution. Holding the edges of the entrance opening apart with flat retractors facilitates this part of the proceeding. The greatest care should be taken not to break down the wall of the abscess at any point, and so endanger the general peritoneal cavity. If the appendix can be found and removed without dangerous dissection, it should certainly be completely excised, the stump being ligated with catgut and cauterized. It is not necessary in abscess cases which are to be packed with gauze to make use of any more complete method of closing the stump. If no portion of stump remains sufficient to allow of the application of a ligature, the edges of the orifice should be inverted and carefully over-stitched.

If the search for the appendix and its removal would clearly endanger the continuity of the abscess-wall, it should be left *in situ*. As has been said before, the life of the patient is the first consideration, and should not be subjected to too great risk for the sake of completeness.

The appendix is often completely destroyed by the suppurating process. When not so destroyed, it is often obliterated by the process of repair, and if it remains and subsequently gives evidence of its presence, it may be removed by a secondary operation when the conditions are much more favorable. Not a few patients have been sacrificed to over-thorough work in handling abscess cases. In children especially, when the abscess is large and the patient feeble and exhausted, the best and safest practice is to do little more than give free exit to pus.

Occasionally a neglected abscess case is met with in which a collection of pus has approached very close to the rectum or vagina or lateral

loin region, and is even "pointing" in one of these situations. In some cases of this description all that is needed or safe is simple incision of the thin abscess-wall and tube-drainage. In others the judgment of the operator will lead him to not only open the abscess at the situation of pointing, but also to make an abdominal incision to facilitate satisfactory after-treatment. The condition of the patient and the situation of the pus-collections will lead to the choice of methods.

A class of cases to which as yet no reference has been made in this article includes those in which the protecting wall of adhesions is either entirely absent or more or less incomplete. In these cases a more extensive involvement of peritoneum than is usual has taken place and is rapidly progressing, and the products of a septic peritonitis have flooded the pelvis or passed upward toward the liver, or have invaded the whole general peritoneal cavity. If not recognized before operation, the condition referred to is usually readily ascertained as soon as the peritoneal cavity is opened. The absence of a protecting abscess-wall and the escape into the wound of septic fluid from various directions are clear indications that a widespread infection of peritoneum has taken place.

In every case where the abscess-wall is imperfect search should be carefully made for distant collections of fluid. A sponge held in a long forceps pushed gently down into the pelvis may reveal the existence in that cavity of a large free collection of fluid. In such cases the peritoneum of the intestine contained in the pelvis will always be inflamed. In other instances it will be evident, as soon as incision is made, that the patient is suffering from a general septic peritonitis involving the entire cavity, the quantity of sero-purulent fluid with pus- and lymph-masses being often very great.

All of these cases of commencing or widespread septic peritonitis require the complete removal of all septic fluid and the thorough cleansing of all inflamed peritoneum. Efficient drainage of the involved areas must also be provided, as after operation the serous exudation is always abundant. Free incision, from four to five inches long, is required in order that the intra-abdominal work may be rapidly and thoroughly accomplished. The appendix should be first isolated and removed and the stump cauterized, especially within. A single catgut ligature is sufficient to close the stump, as the wound will always be left open and packed. More elaborate methods of closing the stump in this class of cases are time-consuming and unnecessary. The neighborhood of the appendix is then to be carefully cleansed, and search made for concretions or other foreign bodies.

For cleansing purposes nothing equals the hot sterile normal salt solution (six-tenths of 1 per cent.). This solution is entirely non-irritating to the delicate endothelium of the peritoneum, and washes, without damaging, the most delicate tissue. The temperature of the solution should be from 116° to 118° F., and this temperature may be sufficiently accurately estimated with the hands. If the hand can bear to be continuously immersed in the solution, it is not too hot. It should be poured freely into the wound, and removed with sponge or gauze pad until the area about the appendix is clean. If the pelvis is found to contain fluid, this should be carefully removed with sponges held in long forceps. The salt solution should then be poured into the pelvis, and

this, again, removed with sponges, and the washing repeated a number of times until the fluid returns clear. The process is facilitated and made more thorough if, while the solution is being poured in, a sponge on a long handle is thrust down to the bottom of the pelvis, and then drawn up and down very much like the piston of a pump. When the pelvis is clean every other infected area should be similarly treated, the intestines, if necessary, being drawn out of the wound. All of this work should be done as rapidly as is compatible with thoroughness, for patients who require such intraperitoneal washings at all are not in a condition to withstand prolonged anæsthesia and manipulation. Drainage should now be efficiently supplied. A glass drainage-tube open at both ends and with lateral small openings, and long enough to reach from the belly-wall to the bottom of the pelvis, should be passed in at or near the lower angle of the wound. A single strip of gauze (preferably iodoform) is to be pushed into the tube from end to end. If a similarly infected area has been found extending high up to the right of the colon, it should be treated in the same manner, and iodoform gauze in strips packed in in considerable quantity beside the tube. Here the tube may often be omitted if free packing with gauze is made. If the whole peritoneal cavity has been involved, one should pass strips of gauze in various directions among the intestines, so that perfect capillary drainage may be furnished throughout. Lastly, the neighborhood of the appendix stump and the whole wide-open wound is to be filled with gauze. In some cases a supplementary incision in the left iliac region is indicated.[1]

Most patients who require the treatment just described are much benefited by receiving, after operation, a stimulating enema containing from half an ounce to one ounce of brandy or whiskey, and a hypodermic injection of one-sixth of a grain of morphine and one-one-hundredth of a grain of atropine. The glass drainage-tube in the pelvis should be swabbed out every four or six hours until found to be dry, and if the patient is doing well and fluid is not found in the tube at the end of twenty-four or forty-eight hours,[2] the tube should be removed, a single narrow strip of gauze being left in its place. The outer dressings should be changed whenever they are found to be quite wet, which will usually be within twelve hours. The deeper packings should not be removed until the end of three days, and some may resist extraction until the fifth or sixth day. To relieve flatulence a large soap-and-water enema may be given by the end of twenty-four hours. By the end of thirty-six or forty-eight hours half-grain doses of calomel, given once an hour for six hours, will usually re-establish the bowel function. When the deeper packings are removed fresh ones should be introduced in their place, but in diminished quantity. This repacking is made much easier if flat retractors are used. Complete change of dressings should now be made every second or third day, the quantity of gauze being reduced on each occasion.

In the opinion of the writer, much better wound-healing is obtained

[1] Here also gauze drainage should be used. Excepting in the case of the pelvis, tube-drainage throughout the abdomen is comparatively valueless. An abdominal sterile gauze dressing with cotton over all is now to be applied, and held in place with firm binder.

[2] The detailed histories of twenty-four cases treated in this manner by the writer may be found in the *New York Medical Record* for March 30, 1895.

if irrigations are entirely avoided. If purulent discharge continues abundant, gentle swabbing with peroxide-of-hydrogen solution is valuable. With the patients who do well under this treatment all the signs of convalescence are very rapidly established, and they are not again disturbed, unless, as occasionally happens, a secondary abscess-formation occurs, in which case, at the end of a number of days of unbroken recovery, the temperature and pulse rather rapidly rise and pain and nausea return. This secondary abscess-formation will be a localized one, originating in some residue of the original exudation which has been left behind in some pocket among the intestines. If it lies near the wound, it will quite certainly open in that direction, or if its location can be made out, it can be opened into the wound with the finger or a blunt instrument. If it lies at a distance from the wound, it should be opened by a fresh laparotomy as soon as its position can be clearly defined.

The treatment of septic peritonitis by operation must of course not infrequently fail, and in these instances only a temporary lull will be noted after the washings have been finished. After a few hours pulse and temperature will rapidly rise, vomiting will return, and distention of the abdomen increase. No secondary interference should be attempted, as the patients are never in condition to survive further operation.

Certain imperfections in the wound-healing after operations for appendicitis deserve careful consideration. Occasionally, soon after operation, fecal discharge into the wound is noted. This may be due to imperfect closure of the stump of the appendix at the time of operation, or to secondary perforation by ulceration or gangrene at or close to the junction of the appendix and the intestine. There may also have been one or more perforations of the caput coli which were either not noted or unsuccessfully closed. Most of these fecal fistulæ close as the wound granulates and contracts, and merely require that the wound be more frequently dressed and packed than is usual. Suture of such fistulous openings in the wall of the intestine soon after the primary operation, and while the wound is actively discharging, is inadvisable, for it is almost certain to fail. When the mucous membrane is everted through such a fistula the application of the cautery to the mucous membrane sometimes hastens closure, and can do no harm. As a rule, definite operation had better be postponed until the wound has at all other points nearly or quite closed. Even then the cautery may finish the healing of the fistula.

Chronic sinus, accompanied or not by fecal discharge, may be due to the retention in some part of the wound of an overlooked fecal concretion, or when the appendix was not discovered, or at least not removed, at the primary operation, a fistula communicating with a perforation in the appendix may persist indefinitely. Such sinuses should be handled cautiously. It is usually very unsafe to attempt to enlarge them by cutting in any direction, for the intestines frequently surround them closely on every side. If operation seems called for and is determined upon, it is generally much the better plan to reopen the abdomen at or near the primary scar. The exudation and adhesions, which were so abundant, will have largely or entirely disappeared during convalescence. If a fresh opening in the abdominal wall is made, the finger can be introduced, and this

new wound then safely enlarged so as to permit of ocular inspection of the interior. The fistulous track surrounded by peritoneum or false membrane, or the appendix itself, may now be discovered. Complete extirpation of the thick-walled sinus or of the appendix should now be done. Or if the wall of the intestine is closely adherent to the anterior abdominal wall, and the fistula opens directly from the gut through the abdominal wall, the intestine may be easily separated, the edges of the fistula trimmed freshly, and the opening closed by inversion of its margins and thorough over-stitching. At the same time the chronic opening through the abdominal wall and skin should be excised.

More extensive operation for the cure of large fecal fistulæ, such as resection of a portion of intestine and end-to-end anastomosis, will occasionally, but rarely, be required.

Most of the wounds that have been treated by wide packing heal imperfectly, in that the muscular and aponeurotic layers of the abdominal wall, and the peritoneum as well, in the line of incision have been kept widely separated, and the interval becomes filled with thin new connective tissue. Intra-abdominal pressure after the patient gets out of bed usually produces within a year some degree of ventral hernia. Cases liable to this result should be provided, as soon as they leave the bed, with a well-fitting broad elastic-webbing band with a hard-rubber plate or a convex pad so arranged as to prevent eversion at the site of the wound. If the patient desires it or if apparatus is not efficient, formal operation for the radical cure of the ventral hernia may be done here as in other parts of the abdomen.

SURGERY OF THE ALIMENTARY CANAL FROM THE ILEO-CÆCAL VALVE TO THE ANUS.

By LEWIS STEPHEN PILCHER, M. D.

TRAUMATISMS.—The anatomical relations of the various portions of the large intestine are such as to cause them to differ somewhat in the manner in which they may react to wounds from that which occurs in the small intestine. The cæcum, the greater part of the ascending colon, and nearly the whole of the rectum are so anchored to the posterior abdominal or pelvic wall as to greatly restrict their mobility. To a considerable, though quite variable, extent also the posterior wall of the large intestine in these regions of fixation named is not covered by peritoneum: the lower three or four inches of the rectum is entirely extraperitoneal. Furthermore, the function of the large intestine does not require an active peristalsis, and its contents are more solid, and hence not so ready to extravasate. As a result of these conditions the apposition of the parietal and visceral peritoneal surfaces at the wound-site is less likely to be disturbed, the formation of protective adhesions is favored, and general peritoneal infection prevented. A wound may involve only the extraperitoneal portion of the bowel. Where there is both a wound of entrance and one of exit through the bowel, one of these may be through the extraperitoneal portion of the wall, and thus by the opportunities for drainage afforded may lessen the tendency to disturbance of the protective adhesions possibly being thrown out about the transperitoneal wound.

Spontaneous recoveries from wounds of the large intestines are related by early surgical writers, and in the *Medical and Surgical History of the War of the Rebellion* (2d Surg. Volume, p. 75 *et seq.*) Otis relates a long series of recoveries from shot-wounds of the large intestine. These include 32 cases of recovery after perforating gunshot wounds of the ascending colon; 1 of the transverse colon; 24 of the descending colon; and 2 in which the descending colon is supposed to have been the site of the injury, but in which precise information is wanting—59 cases in all. Of these, in 50 cases the fecal fistula spontaneously closed within a month in 17 cases; within a year in 28; and in 5 at periods extending from one to five years; in 9 cases it never closed.

The colon may be contused without external wound at any part of its course by the violent impact of a blunt body against the abdominal wall: immediate rupture or later sloughing of the injured part is pos-

sibile in such cases of contusion. When immediate extravasation of the bowel-contents does not occur, it is possible for protective adhesions to form to such an extent as to secure ultimate spontaneous recovery. No statistics are available to show the relative proportion of cases pursuing so favorable a course, nor could any general statistics be a valuable guide in the conduct of any particular case. In those cases where no abdominal section was performed, and yet where the patient recovered, there must always remain an uncertainty as to the exact injury sustained.

A tear of the sigmoid flexure of the colon or of the rectum is an accident that sometimes complicates the attempt to separate adhesions that envelop the pelvic organs.

Perforation or laceration of the wall of the large intestine has occasionally resulted from the incautious use of bougies and by over-distention by enemata in the effort to overcome an obstruction of the bowel. Laceration of the rectum so as to open into the peritoneal cavity has resulted from the introduction of the surgeon's hand into the rectum for purposes of exploration. Distention of the rectum by a colpeurynter for the purpose of elevating the base of the bladder preparatory to a suprapubic cystotomy has in a number of instances produced rupture of the rectum, followed by escape of the colpeurynter through the rent into the cavity of the peritoneum.

Intraperitoneal perforation of the rectum has been caused by the forcible thrusting through the anus of a foreign body, as when the person has fallen upon a sharp body, such as an umbrella, the sharp end of a fence-paling, or a spike, or has been impaled upon the horn of an animal. A fatal perforating gunshot wound of the abdomen is recorded in which the bullet, without any external wound, entered the anus as the individual was bending over his horse, and, having perforated the rectum, ranged upward through the abdomen and thorax.

Foreign bodies, such as stones, sticks, goblets, bottles, etc., which for various reasons have been purposely introduced through the anus, have been carried by retroperistalsis high up the rectum, and even into the sigmoid flexure, producing lacerations of the bowel-wall or perforating ulceration.

Diagnosis.—The determination of the existence of a wound of the large intestine until the wound itself has been exposed and verified by sight is often attended by much uncertainty. The escape of fæces through the parietal wound, if one exists, will establish the existence of a wound of the intestine, and the site of the external wound, together with the character of the fecal discharge, will afford valuable evidence as to the part of the intestine wounded. In the absence of an escape externally of the bowel-contents the existence of the intestinal wound must remain conjectural.

When, as in the case of contusions of the abdomen, there is no external wound, there is no symptom or group of symptoms upon which a positive diagnosis can be based, until by the later development of peritonitis or of rapidly progressive anæmia from hemorrhage the existence of a lacerative lesion is declared. Shock to the verge of collapse, local tenderness, paresis of the bowel with tympanites and arrest of the fecal current, may be present without rupture of the bowel; on the other

hand, rupture of the bowel may exist with but little immediate shock, local tenderness, or intestinal paresis.

The importance of an early diagnosis is, however, great. Therefore careful consideration should be paid to all the circumstances which attend the injury and which lend a strong probability to the supposition that a wound of the bowel exists. The severity of the force, the location of the contusion or external wound, the local tenderness, the general shock manifested,—if these are such as to render probable the existence of an internal laceration of the bowel, a very grave responsibility rests upon the surgeon. He must decide whether he shall wait for the development of unmistakable septic peritonitis or marked hemorrhage before making exploration of the abdominal cavity or shall at once resort to an exploratory incision. This question in relation to abdominal injuries in general has been discussed elsewhere (Vol. I. p. 505), and it suffices in this connection simply to add that the same principles which govern the surgeon in dealing with injuries of other abdominal viscera should be applied to wounds of the large intestine, notwithstanding the greater possibility, already mentioned, of spontaneous recovery which attach to the latter.

The diagnosis of rupture of the rectum or of the sigmoid flexure of the colon by bodies introduced through the anus is generally unmistakable, and at once declared by the circumstances attending the accident. Sudden shock and local pain and rapidly supervening peritonitis declare the nature of the injury. Often by palpation of the anterior abdominal wall the foreign body is felt protruding into the general abdominal cavity.

Treatment.—As soon as the existence of a wound of the intestine has been established, there is but one rational course to pursue: the wound must be exposed and treated upon general surgical principles. Unless incision of the abdominal wall has already been made for purposes of diagnosis, it should be done at once. If doubt as to the exact location of the wound exists, an incision in the median line should be made, since it best facilitates ready and extensive examination of the intestine. When a lateral parietal wound already exists, and there is good reason from the nature of the wounding body to conclude that only the viscus in immediate contact with the external wound is injured, the original wound may be enlarged. In any event, a sufficient incision through the abdominal parietes should be made to secure exposure of the wounded part and to make possible thorough examination and cleansing of contiguous surfaces. If active bleeding is in progress, the bleeding vessel must first be sought for and ligated. If an intestinal wound of moderate extent is revealed, which may be sutured without diminishing the lumen of the gut more than one-half of its capacity, it should be sutured as directed in the previous article.

If the rent exist in those portions of the large intestine which cannot readily be brought up into the wound in the abdominal parietes, it may be very difficult to obtain sufficient access to it to properly suture it. Such difficulty will be especially met with at the hepatic and splenic flexures and in the rectum. The flexures may be best reached by oblique incisions in the hypochondriac regions a little below and parallel with the lower border of the costal arch. Such incisions may be freely prolonged

downward into the lumbar regions, and lend themselves readily to drainage or to the formation of an artificial anus. A wound in the upper half of the rectum may usually be reached by suprapubic median incision, the patient having the pelvis elevated (the position of Trendelenburg), so that the cavity of the pelvis shall be emptied of small intestine. A laterally placed, deep-seated wound of the rectum which could not be reached in this way could be reached from behind by a lateral sacral incision, with osteoplastic resection of the coccyx and lower portion of the sacrum (see page 481), which incision would also be especially favorable for drainage and for a fecal fistula if the suturing should prove inefficient.

For the application of a suture to such deep-lying wounds a fine full-curved needle and a long-handled delicate needle-forceps will be required.

Traumatisms of the extraperitoneal portion of the rectum belong in a category by themselves: they will be considered in connection with Affections of the Anus.

If the area of the intestinal wound be greater than the limitation to suture given above, one of two courses of procedure is possible: either immediate resection of the bowel and immediate anastomosis, or the suture of the injured portion of the bowel into the external wound and the formation of an artificial anus, to be dealt with later as subsequent conditions may indicate. Most frequently it will occur that the depression of the vital forces of the patient at the time of operation will be such as to require as speedy a completion of the procedure as possible, and therefore the resort to the formation of an artificial anus will be indicated. If future experience should show that the cicatrix left after the use of the larger-sized buttons devised for intestinal anastomosis by Murphy will not subsequently contract so much as to produce obstruction, the quickness with which anastomosis may be effected by their use would enable the surgeon to avoid the formation of an artificial anus in a much larger proportion of cases. At present their field of usefulness is still undetermined, but the general trend of experience thus far is against their use in the large intestine. In any case of the class under discussion the formation of an artificial anus is a proper thing to do, and in many cases it is imperative. In establishing an artificial anus the surgeon should keep in mind the future desirability of getting rid of it, and should therefore adopt such a technique as will produce, if possible, a condition that may tend to later spontaneous closure. The indications are the direct opposite of those attending the formation of a permanent artificial anus for the relief of malignant obstruction. Flexion of the bowel or the formation of a spur or septum that may interfere with the ready flow of the contents of the proximal into the distal portion of the intestine is to be avoided. The wound of the bowel should be brought into contact with the parietal peritoneum at the nearest point, where a suitable secondary incision of the parietes should be made if necessary, thus avoiding traction upon the bowel and tension upon the sutures. The peritoneal edges of the bowel-wound should be sutured carefully to the peritoneal edges of the parietal wound. The wound through the parietal, muscular, and connective-tissue planes should be kept patent and frequently cleansed until the peritoneal surfaces within have become firmly

adherent (four or five days), after which time its degeneration into a fistula with tendency to spontaneous closure should be encouraged. If no or little obstruction exist to the fecal flow along the intestine, such spontaneous closure in a few weeks or months may be confidently expected.

If, upon opening the abdominal cavity, it is found that extravasation of the bowel-contents to any degree has occurred, especial care in cleansing and drainage will be required. The extravasated material should be gently but thoroughly sponged out, and counter-openings for drainage should be made so as to tap any adjacent dependent peritoneal pocket. A fold of iodoform gauze or a rubber tube may thus be laid as a drain by the side of the ascending or descending colon, and carried out posteriorly through an incision in the flank, or through the cul-de-sac of Douglas into the vagina, or from the rectovesical pouch backward by the side of the sacrum. By the temporary use of such drains the further diffusion of septic discharges may be prevented and the dangers of peritonitis be greatly lessened.

CONTUSION OF BOWEL WITHOUT RUPTURE.—If, upon exposure of the bowel it be found that no rupture has occurred, but that the intestinal wall is so contused that subsequent sloughing is possible, the injured portion of the bowel should be brought up to the parietal wound and secured in apposition to it by a sufficient number of points of suture through the sound serous covering immediately adjacent to the contused area, and the parietal wound filled with iodoform gauze. In this way, if the injured bowel-coat should subsequently give way, the general peritoneal cavity would have been shut off by adhesions and the fæces would find exit upon the abdominal surface. If the feared sloughing of the bowel should not occur, the parietal wound can be closed by secondary sutures as soon as the continued integrity of the injured bowel is assured.

FIG. 260.

Intestinal fistula formed by spur-like fold of bowel-wall: *A*, upper portion of intestine; *B*, lower contracted portion of intestine; *C*, cutaneous orifice of fistula; *D*, spur.

PERSISTENT FECAL FISTULA.—A fecal fistula may persist as one of the sequelæ of a wound of the large bowel in consequence either (1) of the extent of the loss of substance in the wall of the bowel; or (2) of such angulation of the bowel opposite the point of external opening that a spur-like fold or valve is formed within it (Fig. 260), which prevents the ready flow of the fecal current beyond the point of fistulous opening; or (3) the immediate union of the bowel mucous membrane with the skin, so that a fistula with a continuous muco-cutaneous lining is formed (Fig. 261); or (4) the existence of a deep abscess-cavity with which the fistula communicates, and

from which at a more or less remote point external discharge occurs; or (5) the existence in the distal portion of the bowel of some obstacle to the free passage of the bowel-contents. This obstacle in the case of a wound may be due to cicatricial contraction at the site of the wound beyond the fistulous opening, or to the compression of peritoneal adhesions, or to an angulation of the bowel caused by adhesions: the tonic contraction of the bowel caused by the sphincter at the outlet of the rectum falls into this category of obstacles which cause the persistence of fecal fistulæ after a loss of substance in the wall of the rectum.

A persistent fecal fistula is often produced by the surgeon for the relief of obstructive symptoms caused by inoperable malignant disease of the bowel. An opening with a projecting spur of mucous membrane and with a muco-cutaneous lining is systematically created in such cases, to which the term *artificial anus* is properly given. The discussion of this condition is reserved for another connection. (See page 494.)

As a rule, a marked tendency to contraction, and thus to ultimate closure of fecal fistula, exists, so that in the absence of the conditions above enumerated the final spontaneous closure of such a fistula may be confidently expected. An extensive loss of substance in the wall of the bowel tends to terminate in a permanent fistula, more particularly because, as its edges are drawn up to the cutaneous surface in the process of healing or are sutured to it by the surgeon, some angulation of the

FIG. 261.

Simplest form of intestinal fistula, with muco-cutaneous continuity and slight eversion of mucosa.

intestine is produced, and its wall opposite the opening is thrown into a more or less valve-like fold, while about the margins of the opening the mucous and cutaneous surfaces become continuous. The greater the loss of intestinal wall the more acute the angulation of the bowel and the more prominent the spur. It is true, however, that aside from these complications, the mere extent of the loss of substance may be such that cicatricial contraction alone will be unable to obliterate it. Such extensive loss of substance without other complications could occur only in the course of the large bowel. Again, a large opening into the bowel invites a prolapse through it of the movable bowel above, which acts as an additional force to keep the opening from closing. The most important and constant elements in the production of persistent fecal fistulæ are bowel-angulation, the presence of the internal spur, and the muco-cutaneous lining. Precaution to avoid these conditions at the time of primary interference has already been enjoined: to remove them constitutes the chief indications for subsequent surgical interference when the fistula is to be closed.

Pelvic and abdominal abscesses are the frequent cause of fecal fistulæ. Such abscesses may begin with loss of substance of the bowel-wall, as from ulceration or perforation by a foreign body; or the communication with the lumen of the bowel may be a secondary occurrence, as in the case of many abscesses caused by disease of the vermiform appendix, of pelvic abscesses originating in disease of the uterine appendages, of abscesses resulting from the breaking down of tubercular, carcinomatous, or actinomycotic deposits, of abscesses arising from tubercular caries of the spine or of the pelvic bones. The cutaneous opening and the completion of the fistula may have been spontaneously effected or may have been secured by a surgical incision. It has occurred in this class of cases that unmerited reproach has been cast upon the surgeon by the charge that the opening in the bowel was due to his lack of skill or caution, when in reality the opening already existed or occurred unavoidably and spontaneously from later sloughing. In this class of cases the fistulous tract is long and irregular, not infrequently opening from imperfectly drained cavities in which fecal and suppurative fluids are retained by the backward pressure which prevents the bowel-opening from closing, while the general reparative powers of the body are greatly reduced by the presence of general septic poisoning. In such cases, if a free and direct external discharge of the fecal and septic matters can be secured, spontaneous closure of the fistula will follow in a large proportion of cases.

Similar in nature are the fecal fistulæ which result in the course of pelvic and abdominal operations, when by the detachment of adhesions the bowel-wall is so damaged that it subsequently sloughs or is torn outright and fails to be adequately sutured, or suffers necrosis from the pressure of a drainage-tube. If in such a case a general and fatal peritonitis is escaped by the rapid formation of limiting adhesions, a fistulous tract is created along which more or less fecal matter is conducted to the surface.

Gangrenous strangulated herniæ belong practically to the category of traumatisms of the bowel. When the small bowel is the viscus involved, so urgent are the dangers of rapid inanition from the subsequent escape of the intestinal contents through any resulting fistula that unless collapse is already present or imminent, resection and immediate enterorrhaphy should be performed. When the large bowel is the viscus involved, the conditions are reversed, and the fixation of the gut-end in the wound after resection of the gangrenous portion becomes the operation of choice. The amount of the bowel-wall thus lost either by spontaneous sloughing or by the surgeon's knife will determine the degree of subsequent resulting fecal fistula. All that has been said with reference to such fistulæ from other causes is applicable equally to these fistulæ resulting from strangulated hernia and gangrene.

Characteristics.—The extent of the defect which remains in the bowel-wall after cicatricial contraction has accomplished all that it can, will determine the size of the external fistulous orifice. Should the original skin-opening be relatively small, subsequent undermining and sloughing will take place until sufficient provision is made for a ready escape of fæces. The resulting orifice will be somewhat circular, with margins indurated and puckered from the chronic irritation of the dis-

charges that flow over them. If the orifice be large and the channel of communication with the intestine is direct and short, some amount of prolapse of the intestinal mucosa through it will be quite constant: this will be the more marked according as the intestine immediately above the opening is held loosely by its mesentery. Should the fixation of the involved bowel be such as to prevent much prolapse, the touch or sight may distinguish projecting from the posterior wall of the exposed gut a more or less prominent fold of mucous membrane according to the degree of angulation of the gut present. If, as in the case of artificial anus resulting from gangrenous strangulated hernia or colostomy done for the relief of obstructions by malignant disease, the whole circumference of the bowel has been removed, two bowel-openings may be distinguished, presenting externally like the openings of a double-barrelled gun.

The projecting fold or spur, pressed by the fecal current from above, tends to fall over and cover the orifice leading to the distal portion of the intestine. It directs the fecal current to the external opening, and may so absolutely occlude this orifice as to wholly prevent the entrance of fecal matter into it. Excepting at its projecting edge this spur is formed by two thicknesses of gut-wall, back to back, with a triangular interval between them, which increases the more as the two parts of the adherent loop diverge within the belly. This interval will include the elongated mesenteric attachment. (See Fig. 260.)

The skin adjacent to the fistula is generally more or less excoriated by the irritation of the discharges that flow over it. This skin-irritation is less marked about fistulæ connected with the large bowel than about those through which the more fluid and acrid contents of the small intestine escape, and may be greatly lessened by the use of emollient and antiseptic agents.

The discharge from an opening in the large bowel is more or less consistent according as the opening is at a greater or less distance from the ileo-cæcal valve. In conditions of normal health the escape of formed fæces may take place at such long intervals as to simulate the natural movements of the bowel, and to diminish very much the inconveniences of the disability. Any digestive disorder, however, that may produce undue peristalsis will aggravate them by causing the escape of fluid fæces.

When all the fæces escape through the artificial opening, the empty and disused portion of the bowel below the opening becomes much contracted.

The direct effect upon the general health of an individual produced by a persistent fecal fistula depends upon the portion of the bowel involved and the proportion of the intestinal contents that escape through it. The farther above the ileo-cæcal valve the opening is, the more positive and rapidly progressive the malnutrition produced by the premature escape of the intestinal contents; the greater the distance below the valve, the less the annoyances produced by it. In any situation the escape of the contents of the intestine is beyond the control of the will of the patient, and at the best the disability subjects the patients to constant chagrin and disgust, prevents them from mingling freely with their fellows, and limits their ability to engage in the avocations of life.

Treatment.—In any case of fecal fistula such diet should be chosen as will be non-irritating and will favor the formation of a soft, consistent fecal mass that may readily pass around a limited obstruction and yet not readily escape through the unnatural orifice. Milk and farinaceous foods, with fish and meat, should form the chief elements of such a diet. That position in bed should be maintained which will keep the external orifice uppermost, so that the force of gravity may tend to increase the proportion of fæces that may be retained in the natural channel and favor the retraction of any intestinal spur that may be present.

Pressure over the external orifice by a truss or suitable compress should be constantly maintained. The material of which this compress is made should be non-absorbent, as hard rubber: with it may be combined a plug of any soft material to be inserted into the orifice, to restrain somewhat the too frequent escape of fæces, to press back any projecting intestinal fold, and to prevent prolapse. This plug should be frequently changed. The surrounding skin should be protected by inunctions with oxide-of-zinc ointment. The utmost care to secure all possible cleanliness should be continually exercised. Patient persistence in these palliative measures will sometimes ultimately secure permanent closure of the fistula even in cases that at first seemed very unpromising.

When the fistula still persists, further operative measures will be required, the nature of which will be determined by the conditions to which the persistence is due.

(*a*) *Persistence due to Stenosis Distal to the Fistula.*—The possible existence of stenosis of the bowel distal to the fistula will suggest itself to the surgeon when in the absence of other evident adequate causes a fistula remains persistent. The history and attendant circumstances of the case may quite clearly indicate the nature of this stenosis, as in some cases when the opening in the bowel has been made by the surgeon for the temporary relief of obstruction due to it. The final closure of the artificial outlet must be preceded by either the removal of the obstacle to the normal fecal flow or by the establishment of an anastomotic communication between the portions of bowel on either side of the obstacle. Familiarity with the methods and resources of plastic intestinal surgery, and much judgment and ingenuity in applying them, are required in the proper management of such a case. It must first be determined whether for purposes of exploration and subsequent operation an opening into the peritoneal cavity at a distance from the fistulous opening should be made, or whether, after enlarging the fistula superficially, suturing the wound-defect, and carefully cleansing the parts, an extension of the incision through the parietes so as to detach the adherent gut and open freely the peritoneal cavity should alone be done. The settlement of this question will depend on the nature of the obstacle. Should the fistula have been established on account of the obstruction produced by a distant tumor, as in the case of colostomy and rectal cancer, after the obstructing growth has been removed the attention to the local conditions of the fistula alone will be required. So also in the case of wounds and abscesses in which there is reason to believe that the inflammatory disturbances have been limited to the immediate neighborhood of the loss of substance in the gut; so also in the case of obstruction from

cicatricial stenosis or from neoplasm of the gut-wall when temporary relief to the obstruction has been provided by an opening in the gut immediately above the point of obstruction; so also in cases of gangrenous strangulated hernia or cases in which for any cause resection of the intestine has been required, and the ends of the divided intestine have been secured in the parietal wound, instead of being subjected to immediate suture. In short, whenever the circumstances surrounding the case are such as to render it probable that the obstructing conditions are limited to the immediate vicinity of the opening in the gut, the incision for the purpose of exposing and removing the obstacle should be in the site of the fistula itself. Exception to this rule is to be made when the obstruction is located in a portion of the intestine that is comparatively fixed; also when the site of the opening is in a region in which adequate extent of operative incision is impracticable or undesirable, as when a lumbar colotomy has been made for the relief of obstruction caused by a volvulus or by a neoplasm of the sigmoid flexure. Again, when the location of the obstruction is such that an anastomosis between comparatively distant parts of the intestine is the operation of choice for its relief, a median abdominal incision would be required, as, for example, when right inguinal colotomy has been done for the relief of obstruction at the hepatic flexure of the colon, and an anastomosis between the transverse colon and the ileum is required, or, on the other side, an anastomosis between the transverse colon and the sigmoid flexure is desirable for the relief of an obstruction in the descending colon or beginning of the sigmoid for which an opening in the loin or left inguinal region has been made.

Median abdominal incision for purposes of exploration and operative removal of the possible distant obstacle will be required in cases in which the location and nature of the obstruction has not been ascertained at the time of the establishment of the fistula. This includes a quite numerous class of cases which are subjected to operation for obstruction of the bowels at so late a period that, to avert imminent collapse, the surgeon is forced to content himself at the time with a limited incision through the abdominal wall, through which the first distended loop of intestine which presents itself is seized, and after careful suturing is opened for the escape of the accumulated retained fæces, reserving until a later time, when the powers of the patient may have been restored, the attempt to remove or overcome the obstruction and close the artificial anus. Should the original opening have been made in the middle line, it will naturally be included in the line of the later incision, and the suture of the opening in the bowel and the detachment of the adhesions will in such a case first engage the attention of the surgeon. Not only when the fecal fistula falls in the median line of the abdomen, but also whenever it is located at any point on the anterior or lateral aspects of the abdomen, should it be carefully closed by suture, and most thorough disinfection of the parts about it be made before proceeding to the opening of the abdominal cavity, to prevent septic contamination from it.

The method of exploration of the abdominal cavity and the particular procedures required to remove special forms of obstruction cannot be considered here: each is discussed elsewhere in its proper connection. It must suffice in this connection to point out that in determining the

methods to be pursued in the closure of a large class of persistent fecal fistulæ the surgeon must freely open the general peritoneal cavity, and resort to some plastic procedure for establishing an unobstructed fecal flow along the intestine below the artificial opening.

(*b*) *Persistence due to Angulation at the Site of the Fistula.*—The lesser degrees of angulation may attend fistulæ in which the defect in the bowel is relatively small, but by the adhesion to the parietes the bowel is kept more or less sharply flexed. Such angulation at once disappears when, after suture of the opening, the bowel is freed from its adhesions and dropped back into the cavity of the abdomen. This is the treatment to be adopted for the relief of such cases. It is in this class of cases that cure is occasionally secured by diet, position, and compression. The more marked degrees of angulation are characterized by the presence of the projecting spur caused by the valve-like fold of mucous membrane which has been described: the removal of this forms the first indication for treatment.

Division of this spur by the compression exerted by a clamp applied through the external orifice was first suggested and successfully accomplished by Dupuytren of Paris in 1815. The method is comparatively safe, and is eminently efficient in removing the obstruction caused by the spur. The compressing clamp causes pressure-necrosis of the tissues grasped by it: previous to the separation of the eschar the adjacent peritoneal surfaces become glued together by the plastic exudate provoked by the local inflammation attending the ulcerative process, and thus the general peritoneal cavity is protected from contamination. There must always be some risk that this prophylactic adhesion may not be perfect, or that a loop of intestine may have insinuated itself into the angle of the spur so as to be nipped by the blades of the clamp. In the original paper read by Dupuytren before the French Academy of Medicine in 1828 there were reported 41 cases in which the clamp had been applied; of these, in 3 instances death had followed; in 29 instances perfect cure was obtained; in the remaining 9 the fistula still persisted. Later statistics have not materially changed these proportions (Körte, 111 cases, 11 deaths).

The directions given by Dupuytren for the use of the clamp are as follows: "First seek and find the orifice of each of the two ends of intestine, and determine with exactness the direction of their canal. To find the distal opening is often difficult.

"While the patient lies upon the back one of the branches of the instrument is introduced into one of the intestinal orifices to a depth of one, two, three, even four inches, according to the needs of the case. While this is kept in place by an assistant the second branch is introduced in the same manner into the other end of the intestine: the two branches are then brought together and articulated, after which the blades are approximated by pressing the handles together as in using a pair of scissors, compressing the portion of the intestine between them. The action of the instrument should be slow and gradual, lasting seven or eight days. The amount of pressure from the first should be sufficient to suspend life in the part: it should be increased every second day.

"As a rule, while it is in use patients experience only slight pain at

the moment of the application of the instrument. A small number have colic, nausea, and vomiting. When first applied the clamp is fixed upon the intestine which it has seized: at the end of a few days it becomes a little movable, which mobility progressively increases till it comes away of itself without traction, pain, or bleeding. This final fall occurs in the seventh or eighth day."

The original clamp of Dupuytren has been improved by making the blades approach each other in parallel lines, by substituting the continuous elastic traction of an india-rubber band for the intermittent screw device, and by replacing the comparatively narrow solid blades by steel loops like the bows of an ox-yoke, which serve to punch out a much larger segment of the spur in the same time and without increase of risk.

After the removal of the spur the closure of the external defect still remains to be secured. The difficulties to be overcome will be the same as those in which the extent of the defect and the persistence of a muco-epidermal lining are the conditions that cause persistence.

Immediate complete plastic closure of the bowel-defect, and of the cutaneous orifice at the same time, may be attempted, instead of the somewhat tedious method of Dupuytren. To accomplish this with the least danger of peritoneal contamination it is essential that the opening in the bowel should be securely closed by a transverse row of sutures applied before the peritoneal cavity is opened, and that thorough preliminary disinfection of the operative field should be done. If the case is one in which the entire circumference of the bowel has been lost and the two ends open side by side externally, each should be sutured individually. This preliminary suturing and disinfection having been done, the margins of the opening in the abdominal wall, with the adjacent scar-tissue, should be circumscribed by a suitable incision prolonged above and below until the general peritoneal cavity is opened, and the adherent loop of intestine with its attached strip of skin and scar-tissue is fully freed. This loop is now drawn up into the incision, and out through it if possible, to facilitate the further attentions required by it. The tags of integument and cicatricial tissue that may be attached to it are carefully trimmed away. If it should be evident that, after the detachment of the bowel from the wall of the abdomen, the angulation of the gut has been relieved to such an extent as to cause such a subsidence of the previously existing spur that it is no longer an obstacle to the free flow of fæces along the canal of the gut, the primary provisional line of sutures closing in the defect in the bowel-wall should be buried by an additional line of Lembert stitches applied with great care and exactness to guard against possible fecal extravasation. The condition of the gut is thus made the same as in a simple wound which has been closed by a Czerny-Lembert suture. It should finally be freely flushed with a stream of warm salt solution (6 : 1000), and then dropped back into the abdominal cavity. The wound in the parietes remains to be sutured as in any abdominal section.

Should it be evident, however, that the constriction of the intestine after final complete suture would be so great as to materially interfere with the fecal current (Fig. 262), the original provisional suture would

have to be removed, after clamps or ligatures to prevent access of fecal matter had been applied about the gut on either side some inches away,

FIG. 262.

Opening in intestine, *A*, *B*, too large to be closed by simple suture: after being freed from external fistula, to be elongated to the point *C*, and treated by *adossement*.

and one of four methods would still be available: (1) Anastomosis by *adossement*, the opening in the bowel being enlarged longitudinally until it is about three inches long, and the bowel being then folded on itself so as to bring the two most distant angles together, while the adjacent edges of the incision are sewed together by a series of Czerny-Lembert stitches (Fig. 263). The resulting condition of the bowel is similar, but exactly opposite, to that following the application of the clamp of Dupuytren. By the latter tunnelling of the mesenteric angle is effected; by the method of *adossement* tunnelling of the angulated opposed free border is accomplished. When the mobility of the affected portion of the bowel is such as to permit of *adossement* being used without any strain upon any part of the suture line, it is the method of choice. A cardinal principle in this as in all intestinal suturing is that no tension whatever may be exerted upon a suture. Neglect of this principle will always entail disaster.

FIG. 263.

Anastomosis by *adossement:* intestine folded on itself, bringing the points *A*, *C*, of Fig. 262 into contact; apposed edges of opening sutured; the arrow shows site of restored lumen.

The remaining three methods are available especially where the entire continuity of the gut has been destroyed: they are also of use in other cases when the method of *adossement* is not practicable. They all involve as a preliminary step a complete resection of the bowel. The free ends may then be sutured together by stitches circularly applied (Circular Enterorrhaphy, see page 331), or the two ends may be closed and a lateral anastomosis (see page 333) be effected, or the two ends may be secured together by the button of Murphy. (See page 326.) In dealing with the large intestine circular enterorrhaphy will rarely be considered, on account of the difficulties attending its satisfactory application. The button anastomosis leaves a relatively small opening which will soon contract much, and ought not to be used in the large bowel, whose contents

begin to be somewhat solid. Lateral anastomosis therefore remains as the procedure of choice in the cases under consideration when *adossement* is impracticable.

(*c*) *Persistence due to the Size of the Fistula.*—In these cases affecting the large bowel adhesion to the abdominal parietes is uniformly present. If examination has shown that there is no spur-like obstacle to the fecal current at the fistulous opening, nor other source of stenosis distal to it, and yet spontaneous closure is delayed, the opening in the bowel should be clearly exposed by adequate enlargement of the external orifice, care being taken not to open into the general peritoneal cavity. The whole fistulous tract should be excised, together with the margins of the opening in the bowel: then the refreshed edges of the mucous membrane should be sutured together by stitches of fine silk applied closely and so as to catch only the mucous membrane; then, after thorough antiseptic irrigation, a second row of catgut sutures should bring into contact the remaining coats of the bowel; and finally the layers of the parietal wound should be closed either by crossed silkworm-gut sutures or by tier sutures of catgut or silk. If, when the bowel-sutures have been applied, it is evident that the lumen of the gut is seriously contracted, then the case falls into the category considered in the previous section, and must be treated in the manner there described.

(*d*) *Persistence due to Muco-epidermal Lining of Fistula.*—The final closure of a fecal fistula may be delayed simply by the epithelial lining of the canal, which prevents adhesion of its walls. In the larger defects in which the mucous membrane and the skin are practically continuous, and in which there is usually some prolapse of mucous membrane, this cause of persistence is quite secondary to other conditions: it is in the longer, narrower fistulæ in which the bowel-orifice is retracted considerably from the surface of the skin, and in which the track has become lined with a dense connective-tissue wall covered by epithelium which has extended outward from the bowel and inward from the skin, that the existence of this lining becomes the special obstacle for consideration. It may be removed by systematic excision followed by suture, or it may be destroyed by the actual cautery. In the latter case an active granulating process in the wall of the fistula springs up after the separation of the eschar produced by the cautery: this tends to block up, and may suffice to ultimately completely and permanently close, the fistula. Cauterization of the superficial portion only of the fistula is of no value: the cautery must be introduced through the deepest portion of the tract, down to the bowel-orifice, and must be applied so thoroughly as to destroy the entire pseudo-mucous lining.

(*e*) *Persistence due to Connection with an Abscess-cavity.*—Appendical, pelvic, and ischio-rectal abscesses are the most common causes of fecal fistulæ. In these cases previous to the external discharge extensive dissections of the neighboring connective-tissue planes have often been made, and the final external opening is possibly at some distance from the primary focus of disturbance. The abscess may finally degenerate into a long, more or less tortuous, persistent fistulous tract communicating with the gut at one end and with the skin at the other, or by reason of its imperfect drainage may remain as an ill-conditioned cavity, a fountain of sepsis to the absorbents about it, overflowing on either side into

the intestine and through the external orifice, and preventing the definite closure of either opening. The cæcum, the sigmoid flexure, and the rectum are the portions of the large intestine most frequently involved in such processes. The external opening may form in the inguinal or lumbar regions or in the perineum, not infrequently into the vagina, and occasionally into the bladder. Not infrequently temporary closure of one or both of the openings may take place, only to be followed by re-opening in a short time from the pressure of the accumulating secretion within the abscess-cavity.

The extent of the ulcerative destruction of the intestinal wall may be of any degree, and hence is a point not to be overlooked in its relation to the hindrances to spontaneous closure of the defect; but the chief point to remark in this class of cases is the existence of the imperfectly drained abscess-cavity and the more or less long and tortuous canal. Adequate and free drainage of the abscess-cavity is the first thing to be secured in these cases, either by the enlargement of the already existing openings or by the making of counter-openings. According to the extent of the loss of substance in the bowel-well, and the absence or presence of obstacles to the free fecal flow along the intestine, must the later steps be determined.

Ulcerations of the Colon, with Stenosis from Cicatricial Contraction or the Compression of Peritoneal Exudations.—Ulcerations of the colon occasionally become the subjects of surgical consideration by reason of sequelæ, either immediate or remote—namely, stenosis from cicatricial contraction or from the compression of peritoneal exudations, or perforation with the escape of infective material into the peritoneal cavity.

Extensive loss of substance of the mucous and submucous tissues of the bowel may attend the ulcerative colitis of dysentery and chronic diarrhœa, but this necrosis is in patches or islands which are surrounded by intact mucous membrane, whose elasticity and dilatability suffice to so compensate for the contraction that attends the healing of the ulcers that serious stenosis is prevented. According to Woodward,[1] out of the vast number of cases of dysentery and chronic diarrhœa occurring among the Federal troops from 1861 to 1865 no case of intestinal stricture or stenosis resulting from contraction of dysenteric ulcers was reported to the Surgeon-General's Office either during the war or after to the date of his report, 1879, nor does the Army Medical Museum possess a single specimen, nor had he found in any American medical journal a report of any case of the kind contracted during the Civil War in which the nature of the case was substantiated by a post-mortem examination.

In ulcerations of tubercular origin a different condition presents itself. In the great majority of cases (Woodward) tubercular ulcers spread in the transverse direction, assuming at first an elliptic form, which gradually becomes more and more elongated until ultimately it may almost encircle the intestine.

A frequent site of tubercular ulcerations of the intestine is the ileo-cæcal valve and the adjacent portion of the ascending colon (Fig. 264). More or less of the mucous membrane of the colon itself escapes invasion

[1] *Medical History of the War of the Rebellion*, Part II. vol. i, p. 504.

and remains as islands or bridges of intact mucosa. As new portions of the bowel become involved in the disease cicatrization follows it from below; the appendix and cæcum become drawn up and involved in the cicatricial tumor-mass. Very great narrowing of the ileo-cæcal orifice

FIG. 264.

Tuberculosis at the ileo-cæcal junction: *A*, ileo-cæcal valve destroyed by ulceration; *B*, tubercular ulcer of adjacent ileum: extravasation of intestinal contents was prevented by extra-intestinal adhesions; *C*, tumor caused by enlarged glands and infiltration of mesocolon (from specimen in the Museum of the Methodist Episcopal Hospital).

and of the lumen of the affected intestine beyond it results. These ulcers rarely cause perforation into the peritoneal cavity: such an accident is prevented by the formation in advance of the ulcer of adhesions which cause the perforation to result rather in an entero-anastomosis or a peri-intestinal abscess.

A girdling ulcer may result from the plugging of a terminal mesenteric arteriole by an embolus. The cicatrization of such an ulcer would produce a high degree of stenosis.

Stenosis from the contraction of inflammatory exudates that more or less completely surround the bowel, or from the kinking of the bowel caused by adhesions that hold the bowel in a condition of acute angulation, or by incarceration of a knuckle of intestine beneath an adhesion band, is a much more common sequel of ulcerative disease of the colon.

A circumscribed adhesive peritonitis, with or without ulceration of the intestinal mucosa, especially of the cæcum and flexures of the colon, has been ascribed to simple prolonged fecal impaction (Leichtenstern), the irritation and stretching caused by the blockaded fæces being assumed as sufficient to occasion ulceration of the mucosa, and an insidious chronic peritonitis leading to adhesions and narrowing of the intestine. The frequent occurrence of prolonged fecal retention in the colon and rectum, and the rarity of the occurrence of ulceration and circumscribed peritonitis in connection with it, would rather suggest that the paralysis

of the bowel and the consequent fecal stasis were secondary to a pre-existing ulceration and local peritonitis in the cases in which they are found to be present.

The peritoneal exudate which constricts or sharply angulates the bowel may be entirely extraintestinal in its origin, and ulceration, if present, be secondary to the stenosis. The hepatic flexure is not infrequently bound down by the adhesions resulting from the chronic circumscribed peritonitis provoked by gall-stones in the gall-passages or by neoplasms of the liver. The splenic flexure may be involved in a perisplenitis. The sigmoid loop is frequently involved in the exudates provoked by disease of the uterine appendages.

Ulceration of the mucous membrane is prone to occur in the dilated portion of intestine immediately above the point of stenosis, whatever the cause of the stenosis may be, and is a common cause of death after stricture (Treves). Such losses of substance are the result of imperfect nutrition due to distention and compression, possibly occlusion, of nutrient vessels. Cases have been reported (Moxon, Goodhart) in which gangrene of large portions of the colon have resulted from this cause.

A general septic peritonitis may result from ulcerative perforation of the bowel when the previous formation of limiting adhesions has failed to take place.

The **symptoms** indicating the development of stenosis of the large intestine of ulcerative origin are vague and uncertain. The symptoms of constriction may first become noticeable years after the primary ulcerative attack. A very considerable stenosis may be present without causing much trouble as long as the fæces are fluid, and final absolute obstruction may supervene as unexpectedly and with the same symptoms as in any of the acute forms of obstruction, or perforation of the bowel may declare itself by the sudden onset of the symptoms of acute general peritonitis.

Chronic constipation is the most obvious and generally present symptom; this is frequently interrupted by diarrhœal outbreaks: transient blocking up of the narrowed passage provokes attacks of colicky pain and possibly vomiting. Tubercular disease, spreading along the colon from the ileo-cæcal valve, determines a local tenderness in the right iliac region and an induration suggestive of neoplasm. The spread of the tubercular infiltration to the contiguous structures is common, leading to abscess and fecal fistulæ attended with the superficial and evident signs of local tuberculosis. Solid fæces may accumulate above the constriction, producing a perceptible tumor that may become of considerable size. This may be channelled so as to permit the passage of fluid which the intestinal mucosa, irritated into a condition of a chronic catarrh, furnishes in abundance, and which, mixed with some softened fecal matter, continues to pass through the stricture and be voided as a pseudo-diarrhœal discharge.

Increasing weakness and bodily wasting from the long continuance of the abdominal distress or diffuse septic peritonitis from perforation of the bowel-wall by ulceration may lead to a fatal result while the stricture is still permeable. Absolute obstruction may suddenly develop from the blocking up of the narrowed channel by hard fæces or by

bulky, indigestible ingesta, or from a volvulus, or angulation caused by the dragging down of the portion of the intestine on the proximal side of the stricture by the weight of the material retained in it. Absolute obstruction, again, may be more gradual in its development, the passage of fæces becoming more and more difficult as the stenosis becomes gradually narrower, until finally it is completely arrested.

The symptoms dependent merely upon the obstruction of the large bowel are more slow in their development than is the case when the small bowel is affected. The vomiting is not necessarily feculent, although it may be so.

The **diagnosis** may present every grade of difficulty. Many cases come under the observation of the surgeon only in consequence of the development of acute obstruction at a period when tympanitis and peritonitis have masked the localizing signs, and without any clear history of the antecedent disease. In more favorable cases the outline of the distended portion of the bowel above the stricture may be seen or felt through the abdominal wall: the retained fecal mass may be palpated, or the bowel, distended with fluid fæces, may be outlined by its dulness on percussion. Confusion as to the portion of the bowel which is dull on percussion may arise from the fact that the distended large bowel may be dragged by the weight of its contents into quite another quarter of the abdomen than the one in which it normally lies. Valuable information as to the location of the stricture may be obtained by inflating the bowel through the anus. Auscultation along the bowel during the injection of water through the anus may enable the surgeon, as he follows the gurgling progress of the injected fluid, to determine the point at which it is arrested.

The differentiation of the stenosis of cicatricial contraction from that produced from neoplasms may be impossible, nor is it important from the standpoint of treatment that it be made. The dominating element is the obstruction to the fecal current. When the obstruction is gradual in its advance and of long standing, the history may suffice to render probable the diagnosis of cicatricial contraction or compression by peritoneal exudates. In other cases it may be possible by careful palpation to detect the presence of a neoplasm of the bowel which is the evident cause of an obstruction, but in a very large proportion of cases it will not be until after the abdomen has been opened and the point of stenosis has been exposed to view that the real nature of the disease can be known.

The **treatment** involves exposure of the seat of the stenosis by a suitable abdominal section and either excision or intestinal anastomosis, preceded or not by temporary artificial anus as the condition of the patient may indicate.

INTUSSUSCEPTION.—When a segment of intestine becomes infolded within the lumen of the segment with which it is continuous, and is grasped and held by it, so that a permanent telescoping of intestine within intestine results, the surgical condition termed *intussusception* is produced.

Slight intestinal telescopings, which have produced no symptoms during life and after death present no marks of vascular engorgement, are occasionally found during post-mortem examinations, most frequently

in the bodies of children. They are often multiple, always affect the small intestine, and are probably produced by the irregular muscular contractions that attend dissolution. They have no surgical significance.

Intussusception, while it may occur at any age, is especially frequent during early childhood, being the most common cause of obstruction of the bowels during this period of life. More than 50 per cent. of all cases occur before the age of ten years, and half of these occur during the first year of life.

No portion of the intestinal canal is free from the possible occurrence of this accident, but it occurs with the greatest frequency at the ileo-cæcal junction, the ileo-cæcal valve forming the apex of the segment of intestine that is swallowed by the colon. About one-half of the cases are of this character. The remaining cases occur in the small intestine or in the colon, in the proportion of about two of the former to one of the latter. Double and triple intussusceptions, in which the sheath of the primary invagination is again the subject of an additional infolding, have been noted. They are exceedingly rare.

By the invagination of intestine into intestine a mass is formed composed of three cylinders of intestine, together with the mesentery belonging to the invaginated segment.

As will be seen by inspection of Fig. 265, the outer and middle cylinders oppose their mucous surfaces, the middle and inner their peritoneal surfaces, to each other. The invaginated cylinder is termed the

FIG. 265.

Diagram showing relations of the component parts of an intussusception.

intussusceptum; the ensheathing cylinder is the *intussuscipiens;* the portion of the intussusceptum that is farthest in advance is the *apex;* the tightly-grasped portion of entering intestine and mesentery is the *neck.* The relation of the parts is also well shown in Fig. 266.

The traction upon the mesentery of the intussusceptum draws to one side of the ensheathing bowel the orifice at the apex, and renders it slit-like in form: compression of the mesentery at the neck causes venous obstruction, with resulting congestion, edema, blood-extravasations into the walls of the intussusceptum, and hemorrhage from its mucous sur-

face. A localized peritonitis rapidly supervenes, producing adhesions between the opposing serous surfaces whereby the invagination is rendered irreducible. Later, gangrene may determine perforation and diffuse septic peritonitis. The extent and intensity of this mesenteric

FIG. 266.

Ileo-cæcal intussusception of minor degree: to the right is seen the appendix vermiformis just about to be swallowed (Hutchinson).

strangulation determine largely the after-course of the case. In the more acute cases immediate and continued impermeability of the intestine is caused, and the case advances rapidly toward a fatal issue, with symptoms of internal strangulation with or without perforation and peritonitis.

In less acute cases the lumen of the intestine is never absolutely occluded, or it soon becomes restored by reduction of the swelling of the intussusceptum through a muco-sanguineous flux; but later gangrene of the intussusceptum may supervene, with perforation and septic peritonitis, causing death between the fourth and seventh days in children, during the second week in adults, or possibly not until the third or fourth week. If the gangrene is preceded by adequate adhesions at the neck, infection of the general peritoneal cavity may be prevented, and, after the sloughing of the gangrenous portion, complete recovery may ensue. Such separation occurs in the majority of cases from the eleventh to the twenty-first day, but may be deferred till much later. Even when the intussusceptum has happily been cast off without perforation later difficulties may arise. A portion of the intussusceptum may remain, and, acting as an intestinal polyp, may excite renewed invagination; or an ulcer may persist that may later perforate; or cicatricial contraction at the site of separation may lead to later obstruction; or chronic diarrhœa with marasmus may follow; or septic emboli may be detached from the thrombosed mesenteric veins and excite metastatic abscesses elsewhere. If the strangulation is not so great as to cause gangrene of the intussusceptum, a chronic train of symptoms is produced. The two cylinders become fused together by the adhesion of their peritoneal surfaces. The primary symptoms subside into those of chronic obstruction, which may ultimately be relieved by separation of the invagination, or after months of suffering may terminate fatally by perforation and peritonitis or by exhaustion from diarrhœa and malnutrition. The obstructive symptoms may predominate, while the tendency to strangulation is not so great as to destroy the viability of the intussusceptum. Obstruction may be due to the narrowing of the apical

orifice by the dragging of the mesentery and by the thickening of the invaginated walls by congestion and exudation; the narrowed canal may be blocked by ingesta or by a mucous polyp; the angulation of the intussusceptum may itself be a cause of obstruction. Fig. 267 shows a rare case of angulation producing fatal obstruction, a distant loop of intestine being indirectly involved in the intussusceptum.

The nature of the case is influenced much by the site of the invagination and the age of the patient. The higher up the canal the accident

FIG. 267—*A*.

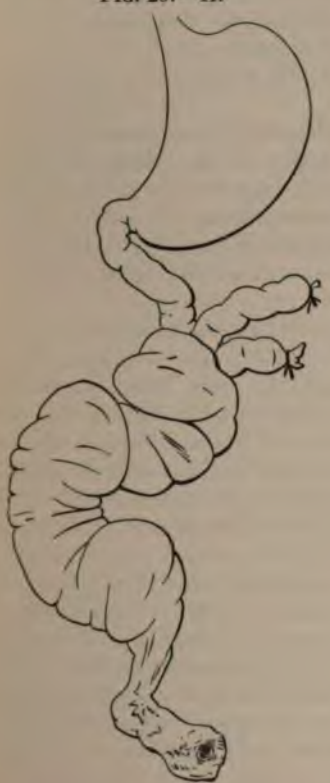
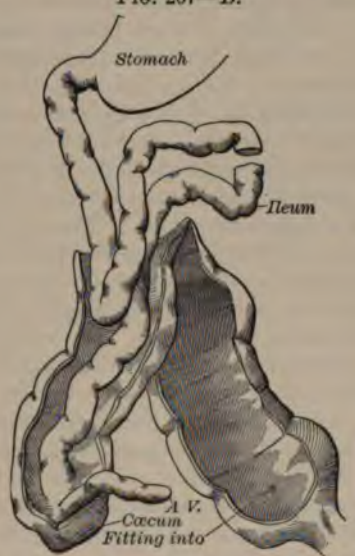


FIG. 267—*B*.



A *B*

Ileo-colic intussusception, with later involvement of loop of duodenum. The apex of the invagination is formed by the ileo-cæcal valve; the lower portion of the ileum, the ascending and the transverse colon are intussuscepted; the sharply angulated loop of duodenum has been drawn in by the traction of the mesocolon (Burge): *A*, external appearance; jejunum and upper ileum, not involved, are cut away; *B*, diagram showing the relation to each other of the component parts; the anterior wall of the sheath and of the outer cylinder of the intussusception is cut away.

occurs the more acute the course. Among children the more acute forms prevail; among adults, the chronic.

The **etiology** of intussusception is confessedly obscure. While it is frequently associated with conditions which excite undue peristalsis, it is as frequently not preceded by notable disturbance of any kind. In occasional instances a tumor protruding upon the mucous surface of the intestine has led to its invagination. This has most frequently occurred in the large bowel. The experiments of Nothnagel appear to show that the inception of an invagination is caused by a relaxed segment being drawn up over a contracted segment by the action of the longitudinal muscular fibres. When once an invagination has been produced, tenes-

mus of the ensheathing portion is excited whereby the internal segment is forced along still farther; the normal traction of the mesentery is prevented from pulling out the part swallowed; the blood-vessels of the mesentery become strangulated; and the chain of congestive and necrotic conditions is inaugurated.

The **symptoms** are usually sudden in their onset: the violent tenesmus causes severe colicky *pain*. The pain may be so great as to cause severe shock and threatening collapse. It is paroxysmal, or, if constant, marked by exacerbations. Periods of colicky spasms may alternate with periods of relief.

Vomiting is usually present from the first: the more acute the case—that is to say, the more marked the conditions of strangulation and obstruction—the more constant and severe the vomiting. In the chronic forms it may be much delayed or absent altogether. In a minority of cases only does it ever become feculent in character. The farther down the intestinal tract the invagination occurs the less marked is this symptom.

Evacuation of bloody mucus, associated with anal tenesmus, is very commonly an early and striking symptom. The more acute the strangulation the more marked the bloody flux. In infants the amount of this hemorrhage is greater than in those older, but it is rarely excessive in amount in any case. The stools generally contain some fecal matter, for the obstruction is not often complete, and for the same reason gaseous distention of the bowels is unusual. The frequency and severity of the attacks of anal tenesmus depend much upon the nearness of the trouble to the anus.

A *tumor*, sausage-like in shape, may be detected in the region of the transverse or descending colon in many cases. Such a tumor is generally more distinct in children than in adults: it is made more marked by the paroxysms of peristaltic spasm; it is not especially tender at first, but becomes so later. When the intussusception is of the ileo-cæcal or colic variety, the tumor can almost always be detected, and in some cases its apex may be felt by the finger introduced into the rectum. It may even protrude from the anus.

Invaginations in the course of the small intestine produce a tumor that is often imperceptible.

Symptoms of perforation of the bowel, of diffuse septic peritonitis, of chronic obstruction of the fecal current, or of other accidents that may complicate the course of the disease may arise as the case progresses.

The **diagnosis** of intussusception is generally clearly indicated by the assemblage of symptoms presented: the sudden onset of violent pain in the abdomen, the subsequent paroxysms of colicky pain, the vomiting, the bloody mucous diarrhœa, the anal tenesmus, point clearly to the accident which has occurred. If the peculiar tumor described is perceptible, the confirmation of the diagnosis is absolute. The occurrence of symptoms of intestinal strangulation in an infant or young child suggests at once intussusception. In adults, especially when the ileum is the seat of the accident, it may be more difficult to differentiate intussusception from strangulation or obstruction of the bowel due to other causes. In occasional instances a finger introduced into the rectum can feel the apex of the intussuscepted intestine.

The **prognosis** of intussusception is always grave. According to the statistics of Treves,[1] 70 per cent. of all cases terminate fatally, and more than three-fourths of these fatal cases die within seven days of the onset of the affection. In infancy and early childhood a rapidly fatal course is the rule. The œdematous and inflammatory changes in the intussusceptum so quickly supervene that not only can spontaneous reduction not take place, but artificial reposition by other than bloody operative measures becomes very early impossible, while death occurs before elimination of the strangulated segment by necrosis can be accomplished.

It is presumable that slight invaginations, producing transient symptoms, may become spontaneously reduced. While the possibility of such cases may be admitted as a matter of speculation, it has no practical bearing upon the prognosis of the cases which develop the persistent symptoms that call for surgical consideration.

Of the cases which survive for more than a week spontaneous termination of the intussusception through the sloughing of the intussusceptum is a common occurrence. In about 40 per cent. of all cases the intussusceptum becomes cast off in this way (Treves), usually from the eleventh to the twenty-first day, but in nearly half of these cases death still occurs from the premature separation of the slough before adequate protective peritoneal adhesions have formed. A not inconsiderable number of those who escape the immediate dangers of the separation of the intussusceptum subsequently perish from later complications.

Treatment to be effectual must be instituted as soon as possible after the intussusception has occurred, and must not stop short of the complete reduction of the invagination. The means that are available are—(1) Quieting peristaltic spasm by opium or chloroform; (2) distention of the colon by water or gas in sufficient amount to push back the prolapsing bowel, this to be combined with inversion of the patient; (3) manual reduction after abdominal section.

Reduction by distention can be successful only before the formation of adhesions and in the absence of much œdematous swelling of the intussusceptum. The earlier the enemata are resorted to, and the less marked the symptoms of strangulation, the greater the probability of successful reposition. If the symptoms have been at all acute, little hope of success can be indulged in if so many as twenty-four hours have elapsed since the beginning of the attack. Previous to the injection of the fluid into the bowel complete relaxation of the abdominal muscles by anæsthesia should be secured and during the injection the patient should be held inverted, so that the force of gravity may reinforce the distention. The distending force should be steady and under complete control. This can best be secured by the use of a long enema-tube attached to a funnel or other receptacle that may be kept elevated at some height above the patient. The height of elevation of the reservoir should not be more than three feet above the level of the abdomen. The utmost gentleness should be used in such efforts at distention, nor should they be prolonged or repeated, lest rupture of the weakened bowel should result.

Apparent reduction may have been secured by the enema, and yet the

[1] *Brit. Med. Journ.*, Aug. 29, 1885, p. 387.

disinvagination be still incomplete. Thus, a prolapsed portion of the ileum into the cæcum might still remain and escape detection by reason of its small size, notwithstanding the disappearance of all appreciable tumor. Persistence of symptoms, accompanied by a gradual redevelopment of the previous condition, follows in such cases.

No advantage from the use of enemata can be looked for when the intussusception is located above the ileo-cæcal valve. Upon the failure to secure entire relief by the use of an enema, abdominal section should be resorted to at once. Especially in the cases in which the symptoms of strangulation have been marked from the first should abdominal section be instituted with as little delay as possible.

Technique.—The incision should be made in the median line of the abdomen, above, below, or through the umbilicus according to the location of the tumor, and should be sufficiently free to permit of ready manipulations within the cavity. The presenting bowels should be unhesitatingly turned out of the abdomen until the intussusception is exposed. The eviscerated intestines should be protected by hot wet towels during further manipulations. The tumor should be grasped between the two hands and firmly and continuously compressed by them from its apex toward its neck until manifest diminution of the œdema of the intussusceptum has been accomplished. Gentle traction should then be made upon the entering bowel at the mouth of the invagination, while any adhesions present are broken up by the fingers or by blunt instruments. Violent or long-continued efforts should not be made, lest tearing of the friable bowel-wall should result. The earlier in the history of the case that these measures are resorted to, the more certainly and speedily will success attend them. That even in young infants, if these measures are resorted to early, a full and uncomplicated recovery will often be secured is proven by many recorded cases.

After the intussuscepted bowel has been entirely disinvaginated care should be taken to pass along through it into the bowel below any fecal matter that may have accumulated above it, before returning it to the abdominal cavity, to avoid later obstructive symptoms from the inevitable partial paresis that will remain for a time. The closure of the wound in the abdominal wall and the later cares are the same as in other cases of abdominal section.

Careful examination of the disinvaginated bowel should be made to discover any points of doubtful viability. If any points of threatening gangrene or of perforation are discovered, resection of the affected area must be done, followed by suture or artificial anus as the special conditions may determine. The efforts at disinvagination may be unsuccessful, either on account of the friable and swollen condition of the intussusceptum or on account of the firmness and extent of the adhesions already formed. If the irreducible invagination is not extensive, it may be resected: in more aggravated cases anastomosis or artificial anus may be resorted to. If an artificial anus is formed, it should be closed at an early date, especially in young subjects, for the gut below the opening shrinks, and its after-development is so slight that the possibilities of restoring an intact digestive tract at a late date are much lessened.

VOLVULUS.—A loop of intestine held by a long and narrow portion of mesentery may become twisted upon itself so tighly as to determine conditions of obstruction to the flow of fæces through it and of vascular engorgement in its own substance. This constitutes a *volvulus*.

Elongation of a portion of mesentery may be congenital, but it is more frequently acquired late in life as a result of prolonged traction by the weight of a loop of intestine in which fecal matter has accumulated and been retained. A secondary contraction of the root of the mesentery due to the vascular conditions resulting from the traction may narrow still more this mesenterial pedicle, and by approximating to one another the ends of this intestinal knuckle predispose to the occurrence of torsion of the segment. When once such pedunculation of the mesentery has been brought about, axial rotation is possible at any time that the necessary combination of intra-abdominal forces may occur.

The normal anatomical formation of the sigmoid flexure of the colon, with its comparatively narrow mesenterial root and its long loop of attached intestine, renders this portion of the alimentary canal more than any other liable to volvulus. Considerably more than half of all reported cases have been twists of this part of the colon; next in point of frequency the lower portion of the ileum has been involved; more rarely, other portions of the intestinal tube.

Volvulus occurs most frequently in advanced life. It is rare at any period of life, and is one of the least frequent causes of intestinal obstruction.

Chronic obstruction from any cause may predispose to volvulus by distention of the intestine above the obstruction and retention of accumulated matters which by their weight drag upon the mesentery. Hence chronic constipation has, in the majority of cases, preceded the occurrence of the accident. The frequency with which fæces are allowed to accumulate in the sigmoid flexure is an additional reason for the relative frequency with which this portion of the intestine becomes involved.

The conditions that result from axial rotation of the mesentery depend upon the compression of the intestine where it is twisted upon itself and upon the venous obstruction in the rotated pedicle. These react upon each other to their mutual aggravation. The segment of bowel involved becomes more and more distended by gas generated by fermentative and putrefactive changes in its contents, while its walls become intensely congested, thickened by infiltration and hemorrhagic extravasations, resulting in ultimate gangrene and perforation should life be prolonged. The greater the distention the more fixed the twist becomes. The condition of the bowel-wall becomes very early such as to admit of the ready transmission of sepsis through it, so that the development of spreading septic peritonitis is not long delayed. The adhesions which attend this early peritoneal inflammation while it is still localized add another obstacle to the undoing of the twist.

The **symptoms** which are caused by a volvulus are those of acute intestinal obstruction, internal strangulation, and meteorism of the involved loop. Severe *pain* marks the beginning of the attack. Pain is constant with paroxysmal exacerbations; at first it is often referred to the umbilicus. *Tenderness* limited to the area of the affected loop is early developed, and with the advent of general peritonitis becomes diffused.

Vomiting is not a constant occurrence—the higher in the course of the intestine the twist occurs the more marked the vomiting. In volvulus of the sigmoid flexure it may be absent altogether, or it may be a late development provoked by the general peritonitis. *Constipation* is absolute. Attempts to overcome it by cathartics or enemata simply aggravate the obstruction and increase the suffering. *Tenesmus* is usual when the sigmoid flexure is involved: it is often incessant and violent. *Meteorism* of the affected loop produces at first a circumscribed tympanitic swelling in that portion of the abdominal cavity occupied by the loop, which may be recognized before the general tympanites, significant of a later general peritonitis, has masked it. The *general state* of the patient is from the first one of much prostration, indicative of the serious nature of the accident which has occurred. The advance of the conditions toward death is rapid and invariable. General septic peritonitis early declares itself by its usual symptoms. Gangrene and perforation may be inferred when sudden increase of prostration and of septic intoxication occurs.

In the **diagnosis** of volvulus it may not be possible to differentiate it absolutely from other causes of intestinal obstruction, but a probable diagnosis may be arrived at by a careful analysis of the succession of symptoms when they have been intelligently observed. Advanced life, previous chronic coprostasis with transient obstructive attacks, sudden development of acute obstruction with tenesmus, early circumscribed meteorism, rapid progressive aggravation of local symptoms and of general prostration, by their combination would warrant the diagnosis of a volvulus. It is important that an early diagnosis should be made, both in order that injurious methods of treatment may be abstained from, and that proper treatment may be instituted before the development of conditions that will make any treatment of no value.

The **prognosis** of a volvulus, left to itself, is hopeless. Some degree of twisting may occur, and then undergo spontaneous reposition, but when the twist has become so close as to provoke the symptoms recognizable as the surgical condition of volvulus, its spontaneous correction is not to be expected. The acuteness of its course depends upon the portion of the intestine affected, being the more acute the nearer the upper end of the intestine the twist occurs, and upon the tightness of the primary twist. Life is seldom prolonged more than a week, although death has been deferred to a date as late as the twentieth day.

Treatment.—Pain and peristalsis should be relieved by opium, and the seat of the twist should as soon as possible be exposed by an incision through the abdominal wall, and manual reposition of the bowel should be effected. Cathartics and attempts to distend the lower bowel by large enemata, either of fluid or gas, are absolutely contraindicated. Everything depends upon the correction of the twist before serious pathological changes have taken place in and upon the intestinal walls.

Technique.—An incision should be made in the linea alba below the umbilicus of sufficient length to admit the whole hand. The distended loop involved in the twist will probably at once present in the opening, and should be immediately drawn out upon the surface of the abdomen. If the site of the twist is not at once exposed by the escape of the first presenting loop or the nature of the obstruction be still obscure, the hand

should be introduced into the abdominal cavity and a rapid exploration be made. Guided by the knowledge thus obtained, other portions of the intestine should be drawn out or sufficient eventration of the intestines quickly produced until the whole of the involved portion and its pedicle is brought within reach of sight and of direct manipulation. The exposed bowels should be protected by being covered with warm moist towels. If the untwisting of the distended loop is not readily effected after it has thus been made accessible, the distention should be at once relieved by making an inch-long longitudinal incision into the convexity of the loop, and through this emptying it of its contents. If now it is found possible to correct the twist, after this has been accomplished the intestinal contents which had accumulated above the obstruction should also be passed out through the opening made, after which the interior of the bowel adjacent to the incision in it may be well irrigated with boro-salicylic solution and the bowel-incision closed by suture. After thorough cleansing the intestine may be replaced in the abdominal cavity. A reef may now be taken in the elongated mesentery by folding it upon itself transversely and fixing this fold by appropriate sutures, care being taken to avoid such angulation of the mesentery as may impede the circulation through its blood-vessels, or its mobility may be destroyed by suturing it to the abdominal wall. If in the bowel-wall there should be detected any small areas of threatening necrosis, they should be infolded and buried by suturing over them healthy peritoneum. Large areas of gangrene demand excision, to be followed by end-to-end suture, lateral anastomosis, or artificial anus as the conditions of the patient may indicate.

If it should be found impossible to unfold the twist on account of adhesions, the involved loop should be excised.

TUMORS OF THE LARGE INTESTINE.—*Benign Neoplasms.*—The large intestine may become the seat of any of the varieties of neoplasm which its component tissues exhibit in other parts of the body. Thus, adenomatous, fibromatous, myomatous, papillomatous, lipomatous, dermoid, and cystic growths have been observed. By the elongation and narrowing of their base of attachment to the intestinal wall they, as a rule, early become pedunculated and hang within the lumen of the intestine as polypoid masses. They vary in size from that of a small pea to that of a chestnut; more rarely they reach the size of a hen's egg, but cases have been reported in which they attained the dimensions of a fetal head (Cripps, Esmarch). They are generally single, but multiple growths are not infrequent, and, occasionally, extensively disseminated and very numerous growths are met with. The rectum is by far the most frequent site of these growths. Unless they attain great size and produce obstructive symptoms, or by their dragging produce intussusception, both of which occurrences are exceedingly rare, they do not usually give rise to any symptoms during life if located within the colon, nor do those which spring from the walls of the rectum often provoke noticeable symptoms until by the elongation of their pedicle they descend into its outlet. Here they produce tenesmus and the sense of discomfort as of a foreign body present, are prone to bleed, and by their extrusion during defecation render the act disagreeable and painful.

Lipomata either occur as pedunculated overgrowths of subserous fat

hanging from the peritoneal surface of the intestine, exaggerated epiploic appendices, or as small polypi springing from the submucous layer and projecting into the lumen of the intestine. They rarely have any surgical importance.

Cysts.—A large mucoid cyst is described by Cripps,[1] the case having originally been reported by Prideaux. *Rectal dermoids* are less rare, several examples having been recorded (Sutton). The usual features of dermoid growths characterized these examples. The patients in some of the cases experienced annoyance from the protrusion through the anus of long locks of hair. Ovarian dermoids sometimes erode the wall of the rectum and discharge their contents into it. These should not be confounded with dermoids arising in the rectal wall.

Fibromyomata.—Growths composed principally of unstriped muscular fibre and of simple fibrous tissue in varying proportions arise in the submucous and muscular coats of the intestine. Usually they ultimately become pedunculated and form dense polyps, generally of small size, hanging within the intestine. In their pure form they are rare; associated with glandular hyperplasia they are more common. The direction of their growth may be peripheral, when they will form dense submucous masses, of varying size, projecting into the ischio-rectal space or more completely filling the pelvis. According to their location and size they entail more or less marked obstruction to the passage of fæces.

Adenomata.—The growths most frequently met with in the large intestine are glandular hypertrophies which develop into pedunculated tumors hanging down within its lumen. (See Fig. 268.) They are more frequently met with in young children, but may develop at any age. Their most frequent site is in the lower portion of the rectum, but they arise in all portions of the bowel. They are usually single, occasionally they are multiple, and rarely they are present in great numbers widely disseminated. They appear as roundish pedunculated growths, usually not larger than a strawberry, rarely as large as a hen's egg, or even larger; their surface is sometimes comparatively smooth; more frequently they are mammillated and lobulated. They are covered by a coarse, evidently hypertrophied mucosa, the mouths of whose crypts and follicles are visible to the naked eye, and exude a viscid secretion. The mass has a fleshy feel and the color of the neighboring mucous membrane. These tumors are overgrowths of the normal glandular structure of the intestine, the follicles of Lieberkühn being the essential element. (See Fig. 269.)

FIG. 268.

Pedunculated adenoma of rectum (rectal polypus) (after Esmarch).

Vascular, connective, and muscular tissues serve to bind together the glandular elements of the growth and form much of its bulk. Upon the varying proportions of the various elements of the new growth

[1] *Diseases of the Rectum and Anus*, p. 295.

will depend its firmness or softness to the touch. The follicles are frequently dilated and filled with mucus.

Adenoma Distobiensis.—Surgeons practising in Egypt describe a form of mixed glandular and granulation-tissue tumor of the rectum caused

FIG. 269.

Section of rectal adenoma; × 250 (Esmarch).[1]

by the irritation of the eggs of the "distomum hæmatobium" or "Bilharzia hæmatobia," a parasite very common in that region. The adult animal lives in the portal and vesical veins. Its eggs are deposited in the smaller venous radicles. By the irritation which they induce a chronic inflammatory and hyperplastic process is provoked in the intestinal walls, which often results in the formation of polypoid tumors. It is in the rectum that the development of these tumors provokes noticeable symptoms, which are the same as those caused by other rectal polypi. Their size is usually not greater than that of a walnut, but tumors of the size of an egg or a small fist are occasionally met with. Microscopic examination of these growths reveals the presence of the eggs and free embryos of the distoma in the connective-tissue spaces. They are found, for the most part, outside the vessels, and are usually disposed in considerable groups, containing as many as twenty.

Papillomata (*Villous Tumors*).—Occasionally, but so rarely as to be pronounced by some authors the rarest of all rectal affections (Matthews), there develops from the rectal mucous membrane an exaggerated wart-like growth, an adeno-fibroma, which is similar in appearance and structure to the papillomatous growths of the urinary bladder. A specimen in the museum of St. Bartholomew's Hospital, London, measures about

[1] "On the extreme left are seen the normal gland-follicles of Lieberkühn, which toward the right become gradually longer and thicker until they reach such dimensions that they find no more room on the level of the mucous surface, and so necessarily become protruded. The cross-sections of many follicles are also seen. The cylindrical epithelium which lines the follicles is likewise hypertrophied. The vascular stroma in which the follicles are imbedded is composed in large proportion of non-striped muscle-bundles" (Esmarch).

eight inches in circumference and was removed during life: it was growing from the posterior wall of the rectum about four inches from the anus, by a broad base (Cripps). Such growths spring from the submucous connective-tissue layer: the confluent villi consist of an axis of fibrous tissue containing blood-vessels, and are covered by cylindrical epithelium. They present also a certain proportion of hypertrophied glandular follicles. The blood-vessels are relatively large and numerous. Multiple delicate villi may compose the growth, giving its surface a smooth velvety feel, or secondary knobbed processes may develop, producing a cauliflower-like surface. By obstruction to the venous return in the narrowing pedicle œdema and cystic degeneration of the tufts may ultimately develop. They have generally a broad base, but by traction a comparatively narrow and elongated pedicle may be formed. They secrete abundant mucus and are prone to bleed. Papillomata occur almost exclusively in adults. Clinically they occupy a position between adenomata and carcinomata, and in cases that have been neglected or in which sufficiently wide extirpation of sound tissue at their base has not been made the later development of carcinoma is not infrequent.

The **symptoms** which are caused by benign tumors are usually so slight as to attract no attention until, by the elongation of the pedicle, the growth presses at the anal outlet. Not infrequently during autopsies polyps are found in the rectum which during life had caused no symptoms. However, in some cases they give rise to bloody and mucous discharges. Should they begin to necrose, the discharges become fetid. The bleeding may be frequently repeated or may occur only at rare intervals. In amount it may vary from a few drops to an alarming quantity. When the pedicle of the growth has become elongated sufficiently to permit it to present at the anal outlet, frequent tenesmus is provoked, with a constant sense of some discomfort in the part as though there was a foreign body to be extruded. The polyp may be extruded at every stool, and from its surface a more or less copious bleeding take place. The stools contain abundant mucus. In the case of multiple small growths frequent mucoid diarrhœal discharges are occasioned in some cases. Not infrequently prolapse of the rectum and (when seated higher up in the colon) intussusception are caused by them. They may provoke inflammatory and ulcerative disturbances at the anal orifice, and thus determine fissure, fistula, or abscess. The frequent losses of blood soon lead to anæmia and exhaustion. The larger growths which do not protrude may cause positive obstruction to the fecal current.

The **diagnosis** rarely presents any difficulty. When the mass protrudes ocular inspection suffices to determine its nature. In other cases the finger introduced into the rectum will feel the roundish, soft, movable body, although a small soft polypus with a long slender pedicle may elude the finger unless a carefully conducted exploration of the interior of the rectum is carried out. In children the frequent recurrence of bleeding at stool should excite suspicions of the existence of an adenoma, and should lead to careful exploration of the rectum.

By the gradual attenuation of the pedicle adenomata are not infrequently finally spontaneously separated and discharged at stool, after which the previously existing symptoms subside.

Treatment.—Only those growths which cause symptoms—practically therefore only those seated in the lower portion of the rectum—call for treatment. Excision after ligation of the pedicle is the course to be adopted. The ligation of the pedicle should not be omitted in any case. Later bleeding from vessels which at the time of the removal of the growth gave no trouble has so often been reported that the precaution in all cases to secure the pedicle by a ligature should be observed. If the pedicle is thick, it should be transfixed and ligated in two portions. If the base is broad, more especially in the case of papillomata, a more extended and formal excision of that portion of the rectal wall from which it springs should be made.

MALIGNANT NEOPLASMS.—*Carcinoma* of the large intestine is a relatively common disease. The small intestine, on the other hand, is rarely the primary seat of cancer. Out of 7878 cases of carcinoma collated by Williams from the recent records of four London hospitals,[1] 499 had their initial seat in the intestine, 401 of these involving the rectum. Out of 3718 surgical patients of all kinds treated at the Methodist Episcopal Hospital in Brooklyn during the seven years from 1888 to 1894, inclusive, there were 31 cases of carcinoma of the large intestine; of these 16 were in the rectum, 9 in the sigmoid flexure of the colon, 3 in the descending colon, 2 in the cæcum and ascending colon, and 1 at the hepatic flexure. Sutton[2] estimates that of every 100 cases of carcinoma of the intestines 98 will have their seat in the large intestine, and that of these, 75 will occur in the rectum, 10 in the sigmoid flexure, 4 at the splenic flexure, 3 at the hepatic flexure, 2 in the cæcum, and 4 at intermediate points. These proportions are of course only very broad generalizations. It may be sufficient to say that from 6 to 8 per cent. of all cases of carcinoma have their origin in the large intestine, and that by far the larger proportion of these occur either in the rectum or in the sigmoid flexure.

Histologically, carcinoma presents the same structure in all parts of the large intestine: it is essentially an irregular and progressive proliferation of epithelial cells originating in the normal glandular structure, the follicles of Lieberkühn, the new tissue infiltrating the submucous tissue and early undergoing inflammatory and degenerative changes.

In many cases the microscopic appearances resemble closely those of the benign adenoma: they are to be distinguished only by the course of the growth of the glandular hyperplasia. In simple adenoma the hyperplasia is restricted to the mucous membrane and produces an outgrowth from it; in carcinoma the new formations infiltrate also the submucous tissue and spread laterally; later masses of irregular cell-formations make their appearance. In its earlier stage pedunculation of a carcinomatous growth may be present, resembling so much a simple adenoma that for a time it may be impossible to clinically distinguish it as malignant. The tendency to a broadening infiltration at the base of such a growth which sooner or later declares itself marks it at once as a carcinoma.

By a superficial necrosis, which after a time is sure to occur, beginning usually at the centre of the growth, necrotic and inflammatory conditions become engrafted upon the original adenoid hyperplasia. The

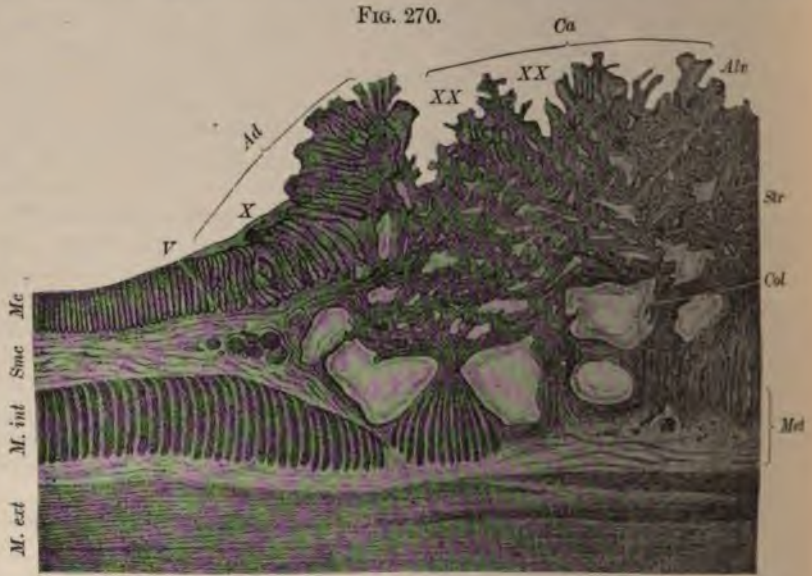
[1] *Annals of Surgery*, 1891, xiv. 270. [2] *Tumors.*

ulcerative process is aggravated by the irritation of the fecal matters that flow over it. At the same time, degenerative changes in the deeper portions of the tumor may arise by distention of many of the glandular recesses with a mucoid material, whereby distinct alveoli distended with gelatinous substance are formed. In other cases increase of the fibrous-tissue stroma may be especially marked, forming a more dense contracting infiltration.

Fig. 270, which is reproduced from Esmarch's work,[1] shows these various degenerative changes.

The tumor which results from the changes just described may project as an irregular lobulated mass from the mucous surface of the

FIG. 270.



Section showing degenerative changes in carcinoma of the rectum: *Mc*, mucosa; *Smc*, submucosa; *M. int*, inner muscular fibres (circular); *M. ext*, outer muscular fibres (longitudinal); *V*, blood-vessels; *Ad*, margin of growth, showing hypertrophied follicles and submucous tissue infiltrated with new adenoid tissue; *X*, mucus; *Ca*, ulcerated portion of the superficial surface of the growth; *XX*, remains of gland-follicles still recognizable; *Alv*, glandular recesses dilated into distinct alveoli; *Col*, large alveoli filled with mucoid or colloid materia; *Str*, stroma; *Met*, adenoid proliferation infiltrating deeper layers of bowel-wall.

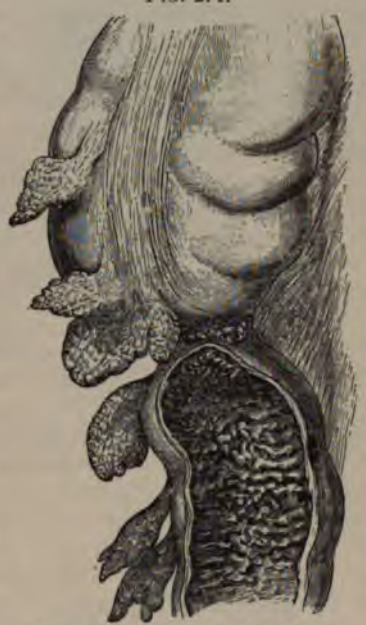
bowel, with a broad but yet quite circumscribed base. More frequently the new growth spreads peripherally in the submucous tissue, without projecting much upon the mucous surface. The infiltration extends most rapidly along the course of the vessels and lymphatics around the bowel, forming a ring of carcinomatous tissue encircling it. This ring may be comparatively thin, possibly not more than a quarter of an inch in thickness, and in width also quite narrow, even less than an inch, while it still extends completely around the bowel and by its contraction may entirely obstruct it. Such annular malignant constrictions are especially common in the upper portion of the large intestine (Fig. 271).

The rapidity of the progress of intestinal carcinoma varies much in different cases: the infiltration may very gradually extend and second-

[1] *Die Krankheiten des Mastdarmes und des Afters.*

ary complications may be long delayed; in other cases early infiltration of adjacent tissues occurs, accompanied by early necrotic changes. Secondary deposits by a transmission of carcinomatous material along the lymphatics follow the course usual to carcinoma in other parts of the body. When the rectum is the seat of the initial disease the pelvic and lumbar lymph-nodes are first involved; then those glands lying in the course of the external iliac artery. If the skin of the anus is involved, then the inguinal nodes may become infected. In a large proportion of cases the liver becomes the seat of secondary deposits. Occasionally a widespread dissemination occurs, with nodules in liver, lung, kidneys, and bones. In all these nodules examination will reveal the cell-arrangement peculiar to the glands of Lieberkühn (Sutton).

FIG. 271.



Annular carcinomatous infiltration of colon (Sutton).

The carcinomata of the squamous epithelial type, which take their origin externally in the skin at the verge of the anus, belong to a different category from those of the cylindrical-celled (adenomatous) type, which arise in the intestine itself. Epithelioma arising at the anus is not a very rare affection (proportion of about 3 cases of disease of the anus to 40 of disease of the rectum proper—Williams). Such growths present the histological characters of epitheliomata in other parts of the body. Anal epitheliomata tend to grow superficially rather than to spread up the rectum. Secondary metastatic deposits are late in occurring, and a great probability exists of their complete extirpation being accomplished by early and extended excision.

Carcinoma of the large intestine is extremely rare before the age of twenty. It becomes progressively more frequent as age increases. Of the 31 cases personally observed by the writer, in 3 cases the disease occurred in persons between twenty and thirty years old; 9 between thirty and forty years; 8 between forty and fifty; and 11 in persons over fifty years of age.

The large intestine may become involved in carcinomatous growths which have arisen primarily in some other organ; as, for example, the kidney, the liver, or one of the pelvic organs. The following very interesting mode of secondary involvement has been observed by Warbasse: In a case of rapidly growing carcinoma of the pylorus cellular elements became detached from the peritoneal side of the growth, and, gravitating to the bottom of the cul-de-sac of Douglas, became implanted there and developed a carcinomatous growth which infiltrated the subperitoneal tissue of the rectum until it nearly encircled it.

Course and Termination.—Carcinomatous disease of the bowel in

its earlier stages gives no well-marked signs of its presence, so that it is usually unnoticed until the development of decided obstructive symp-

FIG. 272.

Carcinoma at hepatic flexure of colon: intestine laid open to show the growth, the margins of which, *B*, *B*, were in contact when the intestine was intact (from a specimen in the Museum of the Methodist Episcopal Hospital).

FIG. 273.

Carcinoma of hepatic flexure of colon, same case as Fig. 272: margins of incision replaced in apposition to show the circular stenosis caused by the growth.

FIG. 274.

Carcinoma of cæcum and ascending colon, intestine opened longitudinally on its anterior face: *A*, *A*, primary growth projecting into cavity of intestine and nearly obliterating its lumen; *B*, *B*, carcinomatous masses infiltrating mesocolon and mesentery; *C*, ileo-cæcal valve; *D*, ileum; *E*, cæcum; *F*, appendix (from specimen in the Museum of the Methodist Episcopal Hospital).

toms awakens suspicions of its presence, and even then its existence must often remain conjectural until autopsy, either operative or post-mortem, gives absolute demonstration. A very large proportion of cases of obstruction of the bowels which have come under my notice have been due to carcinoma of the large bowel, whose existence was entirely unsuspected until the final dénouement. Such was the history of the case depicted in Figs. 272 and 273.

Occasionally a tumor distinguish-

able upon palpation through the abdominal wall will form without producing absolute obstruction or with only a temporary obstruction, relief occurring by the sloughing of a portion of the obstructing mass. While the most characteristic feature of these growths is their tendency to annular infiltration of the wall of the bowel, and by contraction to close the lumen of the bowel as by a narrow band, in some cases a more diffused infiltration along the bowel-wall and into the mesentery or mesocolon takes place, producing a distinctly appreciable tumor and converting the lumen of the bowel into a narrow, tortuous channel traversing the cancerous mass, which may allow liquid matters to trickle through. Such a condition is illustrated in Fig. 274, which represents a specimen removed by me by operation from a man of thirty-one years of age, in the right side of whose abdomen a well-defined, fusiform, nodular tumor, extending from the hollow of the ilium to the costal arch, could be readily felt through the abdominal wall.

In cases in which absolute obstruction is escaped the dilated portion of the bowels above the constriction may become perforated by ulceration, resulting, according to the relations of the perforated bowel, either in fatal peritonitis or in post-peritoneal extravasation and fecal abscess and fistula. A man about forty-five years of age came recently under my care on account of a huge abscess in the right lumbar and iliac regions. Some time after it had been opened by incision fecal matter began to appear in the discharges. His general health rapidly failed, and after some weeks he died, no symptoms of bowel obstruction having at any time been present. Autopsy showed the ascending colon midway in its course to be the seat of an annular carcinoma, which had constricted the lumen of the bowel so that it hardly admitted the index finger. In the middle of the mass on the outer side of the bowel was an ulcerative opening which was continuous with a fistulous tract which communicated with the operative opening in the loin.

Again, adhesions between the bowel primarily affected and an adjacent bowel may occur and an ulcerative anastomosis be established. Should such an anastomosis be effected with a portion of the intestine below the primary seat of disease, relief to previous or prevention of later obstruction might thus spontaneously result. Not infrequently such a "cut-off" route may be established artificially by the surgeon as the best resource in cases which do not admit of radical extirpation. Such adhesion and perforation may take place into a neighboring hollow viscus, as the bladder or the vagina.

A carcinomatous growth in the wall of the intestine may provoke intussusception, and be discovered only during operation for relief of this acute condition. Magill[1] reports 17 cases of invagination at the cæcum due to carcinoma. These all were subjected to resection of the ileo-cæcal coil for their relief.

An intestinal catarrh arising above the seat of the growth may suffice to keep the fæces so liquid that complete obstruction may be avoided even though the stenosis of the bowel be very close. In such cases constipation alternating with diarrhœa is the rule. Evacuations may contain also products of the breaking-down of the growth, much highly offensive shreddy material being added to the muco-feculent diarrhœal discharge.

[1] *Annals of Surgery*, xx. 651.

Cases in which obstructive crises are escaped or overcome or perforative phenomena do not occur pursue the usual course of internal cancer. Progressive emaciation, loss of strength and appetite, and the general appearance of cachexia mark the continued absorption of noxious products from the growth as it breaks down, and the interference with the functions of important organs that become the seat of metastases. Death by asthenia finally closes the scene.

Carcinoma seated in the lower two-thirds of the rectum presents some features that are peculiar to itself. As in other parts of the bowel, it may exist for some time and reach extensive development before provoking symptoms that arouse attention. This is especially the case when the slowly-growing, flatly-infiltrating, annular form of growth is present, which ultimately declares its presence only by the extreme obstruction that it causes. The more common form in this region is that in which a more distinct tumor is produced, which early invades neighboring structures and rapidly breaks down, producing pain, offensive discharges, and the irritation and suffering peculiar to disturbances at the outlet of the bowel. The symptoms that are provoked depend upon the amount of obstruction to the free passage of fecal matters, the extent and rapidity of the ulcerative destruction of portions of the growth, the extent and character of the involvement in the disease of adjacent tissues and organs, the amount of pressure and irritation of the sensitive structure at the anal outlet by the mass of the growth or by the acrid discharges which come from it, and lastly from the presence of metastases and general septic absorption.

As regards the *obstructive symptoms*, it is not infrequent that the voiding of the fæces is never seriously interfered with on account of early and progressive disintegration of the surface of the growth, whereby a channel for the passage of the fæces is kept open. When, however, the obstruction is pronounced, much straining and tenesmus is liable to occur, being more marked the nearer the outlet the obstructive growth is seated. When the constriction is at the outlet or is forced down to it by the straining efforts at stool, the fæces may be voided in thin tape-like form or in small pea-like balls. More frequently the frequent efforts at relieving the bowel bring away each time merely a slight amount of feculent material mixed with muco-pus, constituting a spurious diarrhœa: frequent admixture of blood in the stools often leads to the belief that the patient is suffering from a chronic dysentery. Obstinate constipation not infrequently alternates with the condition of spurious diarrhœa. Ulcerative perforation into the perirectal connective tissue may permit fecal extravasation into the ischio-rectal space and lead to the formation of widely-dissecting abscesses and fecal fistulæ.

A *sanious fetid discharge* is produced by the breaking down of the growth. This will contain shreddy débris from the sloughing surface and is frequently mixed with blood. *Bleeding* to any considerable amount is, however, rare. These discharges at first appear only at stool; later they may also leak away in the intervals, and not infrequently, when the growth is seated low and the sphincters become relaxed, they flow away continually. These discharges are acrid and tend to inflame and excoriate the anus and the adjacent skin. *Pain* is a late symptom, and indicates usually extension of the growth

beyond the bowel. Growths confined to the substance of the bowel are never the seat of pain. The discomfort of obstruction and the colicky straining distress attending the exaggerated peristalsis required to produce a stool will gradually develop as the obstruction increases, and will cease with whatever relieves the obstacle.

The earlier sensations experienced are those of vague discomfort in the pelvis, accompanied by a feeling that the bowel has not been completely emptied. As the disease advances, the nearer it approaches the anus the greater is the pain that is excited by pressure and irritation of the sensitive structures of the anal outlet. Acute pain and tenesmus attend the often-repeated efforts at defecation, while the excoriated anal verge becomes exquisitely sensitive. Intercurrent inflammatory complications in the perirectal tissues may bring at any time an additional source of pain. As the disease extends beyond the wall of the bowel into the adjacent tissues the nerves of the sacral plexus become involved, and a more or less constant, dull, aching pain in the sacral and lumbar region results, which tends to spread to the hips and extend down the thighs.

The involvement of adjacent organs adds the symptoms peculiar to each. Obstruction to the flow of urine may arise from prostatic involvement; cystitis from the breaking down of the growth within the bladder; hydronephrosis and nephro-pyelitis from involvement of the ureters. Pressure on the iliac veins may cause œdema of the legs. The continuous auto-intoxication that results from the constant absorption of septic products from the disintegrating growth leads to progressive emaciation and loss of strength and the production of the characteristic facies of cancerous cachexia even in the absence of much local pain. Metastatic deposits in other organs accelerate the general failure.

For the **diagnosis** of carcinoma of all that part of the large intestine lying above the reach of the finger introduced through the anus actual inspection and handling through an incision of the abdominal wall will usually be required. The presence of obstructive symptoms becoming gradually more pronounced in a person of middle age or beyond it, with progressive loss of strength and flesh, should awaken suspicion of a malignant growth at some part of the large intestine: if upon palpation along the course of the intestine a tumor can be felt, the suspicion will be increased to a probability. Attention has already been directed to the fact that very often the disturbance caused by the presence of the growth is so trifling that it attracts no serious attention until complete obstruction occurs. Yet in these cases inquiry will usually elicit a history of pre-existing constipation or of alternating constipation and diarrhœa, and of some loss of flesh and strength. When once the abdomen is opened and the seat of the obstruction is exposed to sight or touch, the contracting, densely-infiltrating tuberous growth in the intestinal wall cannot be mistaken for anything else.

Ileo-cæcal tuberculosis associated with a mass of large glands (see Fig. 264) may produce conditions that to the touch closely simulate carcinoma, but the usual presence of evident tuberculosis in other organs or regions will serve to suggest the real nature of the disease. Tuberculosis leads rarely to obstruction: the flatly-infiltrating tubercular deposits

in the wall of the intestine early ulcerate, and the tumor that results is due to inflammatory infiltration of the adjacent connective tissue and to glandular enlargement.

Carcinoma of the ileo-cæcal valve or of the cæcum may be mistaken for a chronic appendicitis: the exposure of the parts in the operation that should be instituted for the relief of the latter condition would lead to the detection of the actual condition present.

The existence of a growth along the lower six inches of the rectum can be detected by the finger introduced through the anus: if the patient be made to strain and bear down, an additional length of the intestine may be brought down, and this may be increased still more if the examination be made while the patient stands up. To a point higher yet, readily as far up as twelve inches from the anus, the interior of the rectum may be inspected through a suitable speculum, as will be pointed out in the section on Exploration of the Rectum. In the case of high-lying growth bimanual examination under ether may give valuable information.

The exploring finger detects that the bowel is reduced in calibre by a more or less extensive brawny infiltration, which may occupy a portion only of the circumference of the bowel or may entirely encircle it. From its free surface project nodular tuberosities. If the growth has begun to break down—a case rarely presents itself for examination before this stage is reached—irregular excavations will be felt in the mass; a crater-like ring of indurated tissue surrounds the ulcerated surface: often the finger appreciates that it is grasped by an irregular ring of breaking-down tissue, through which a narrow channel leads beyond. In exceptional cases a polypoid mass will be felt, closely simulating a benign adenoma, but having a broader base, which sooner or later displays an extending infiltration into the submucous tissues.

It is important with reference to prognosis to determine the degree with which the disease may have extended along the bowel or into adjacent tissues. Still, the greatest possible care should be exercised when the disease has encircled the bowel in attempts to pass the finger through to a point beyond the growth, lest the friable wall should be torn through and the peritoneal cavity entered. The finger for this reason should never be forcibly pushed through a carcinomatous stricture, and even the softest bougies should be used with great caution. Numerous cases of fatal rupture from disregard of such precaution have been reported.

Carcinoma of the lower rectum must be differentiated from benign growths, from syphilitic and tubercular deposits, and from the hyperplasia and constriction attending simple chronic ulcerative inflammation. The characteristics of benign growths have already been dwelt upon: too much emphasis, however, cannot be laid on the fact that a growth with a base broadly infiltrating the wall of the bowel is presumably malignant. The microscopic characters of a section involving the whole thickness of the base of such a tumor would certainly reveal its real nature, and would distinguish it likewise from gummatous and tubercular deposits.

The duration of the symptoms may be helpful in establishing the diagnosis. A history of rectal trouble, extending over many years con-

traindicates malignancy, but it must not be forgotten that carcinoma may become engrafted upon a primarily non-malignant disease. Ordinarily, the course of a case of rectal carcinoma after it has become appreciable is rapidly downward. The extension and breaking down of the primary growth and the early formation of internal metastases determine such a progressive enfeeblement that life is rarely prolonged for more than two years. Syphilitic infiltration of the lower rectum, with ulceration and contraction, can hardly be mistaken for carcinoma. The history is a much more chronic one. The infiltration is more diffuse and lacking the hard, nodular feel of carcinoma; the ulcers are more superficial, not crater-like and not suggestive of the breaking down of a hard new growth. A history of syphilis can usually be elicited by proper inquiry.

Tubercular ulceration requires to be differentiated more particularly from carcinoma involving the verge of the anus. It does not tend to form an exuberant tumor-like mass; its ulcers are shallow, with undermined edges; if it extends into the rectum, it is by an extension of an ulcerative process that has begun at the outside and has involved the rectum; the microscope reveals the changes of tubercular inflammation and the presence of bacilli; there is often coincident tuberculosis in other organs.

Cicatricial stricture consequent upon non-specific ulcerative disease of the rectum does not present any nodular ulcerating masses, presents to the touch a smoother, more regular surface, and has had a chronic course with a history of long-standing rectal disease.

Traumatic stricture is felt as a dense, sharp-edged ring constricting the calibre of the intestine; it presents none of the characteristics of carcinoma except that of being a cause of obstruction. Pelvic growths originating outside the rectum may press upon it, so as to produce obstruction, or may involve its substance by extension. Care as to the antecedent history of a case and in the examination of the relations of the particular growth will prevent its being mistaken for a growth arising from the wall of the rectum itself.

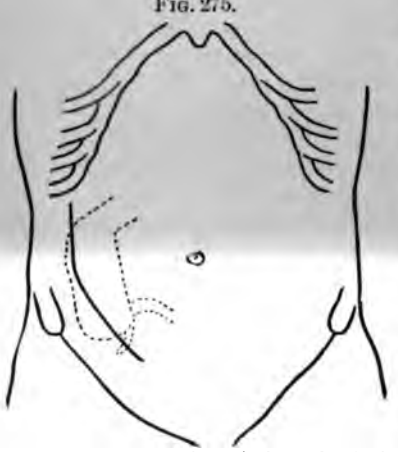
Treatment.—Carcinoma of the large intestine should be extirpated by the knife whenever it is detected before its extension into neighboring tissues has become so great as to make radical extirpation impossible, and before metastases are evident. When radical extirpation is clearly impracticable, obstruction of the bowel is to be relieved or guarded against. Many cases come to the surgeon's notice only when positive obstruction is already complete, and the temporary and immediate relief of this obstruction is the dominant and urgent indication. Systematic consideration of the problems involved may best be secured by discussing in succession the methods available in (*a*) growth confined to the bowel; (*b*) growth diffused or complicated by metastases; (*c*) obstructive symptoms urgent and with consequent manifest exhaustion.

(*a*) *Growth confined to the bowel,* obstructive symptoms not urgent or already relieved by previous interference. In this class of cases the surgeon is able to choose his time for interference, and to systematically consider and provide for the possible contingencies of the case, while the general strength of the patient, not being yet materially impaired, may be such as to make prolonged operative manipulations possible. In a

considerable proportion of cases a previous colostomy will have been done for the relief of the obstruction, in the course of which operation, if not before, the character and site of the neoplasm will have been ascertained. The particular operative methods employed will vary according as the growth invades—(1) the ileo-cæcal valve and cæcum; (2) the colon in any part of its course; (3) the upper and middle portions of the rectum; (4) the lower third of the rectum, including the anus. Each of these regions requires consideration in order.

Extirpation of the Ileo-cæcal Valve and Cæcum.—The possibility of this procedure being successfully resorted to has been only recently demonstrated. The first successful extirpation was done by Maydl in 1882. Three years before Krausshold had first practised it, but with a fatal result. Similar unsuccessful attempts had in the mean time also been done by Billroth and Czerny. Magill, writing in 1894,[1] was able to gather reports of 45 cases in which carcinomatous growths had been excised, with a total operative mortality of 33⅓ per cent. Much of this mortality was due to faulty technique, and may be avoided by increased experience and improved methods of operating.

FIG. 275.



Line of the incision through the abdominal parietes for exposing the ileo-cæcum.

The ileo-cæcum may best be reached through an incision in the right side of the abdomen, beginning above, midway between the costal arch and the crest of the ilium on a line with the anterior border of the axilla, descending to within an inch and a half of the anterior superior iliac spine, and then curving forward and running parallel with the ligament of Poupart, half its length and an inch and a half above it. Fig. 275 shows this line of incision. This incision may be extended in either direction as required in the course of the operation: it should be long enough to give full and easy access to the parts to be removed. Its length will therefore vary in different cases, but the average length required is about five inches.

Through this incision the lower part of the ileum should first be drawn out, and divided between two ligatures temporarily tied about it. Pieces of iodoform gauze, twisted into a loose cord and carried through the mesentery by a blunt forceps, will serve well for these ligatures: the contents of the bowel should first be carefully stripped back beyond the point where the highest ligature is to be applied; the ligatures should be applied about four inches apart, and the section of the bowel should be made close to the lower one, so as to leave at least three inches of empty healthy bowel beyond the upper ligature for subsequent manipulation. The open ends of the intestine and their interiors should now be carefully irrigated with boro-salicylic solution, care being exercised

[1] *Annals of Surgery*, 1894, xx. 642.

to prevent infection within the peritoneal cavity. These ends of the ileum should now be enveloped in a warm compress, and the division of the ascending colon next be made in the same manner, the section of the colon being made just beyond the proximal ligature, the distal temporary ligature having been applied about four inches farther along the bowel than the point of section. The diseased segment is thus isolated from the rest of the bowel. Its cut ends, enveloped in gauze, may now be dropped back into the abdominal cavity and only the bowel-ends that are to be joined kept in view.

Restoration of the continuity of the intestinal canal should be effected before proceeding with extirpation of the diseased segment. Continuity of the canal may be restored either by circular enterorrhaphy, after cutting the end of the ileum obliquely so as to give it the same calibre as the colon, or by lateral anastomosis by suture or approximation disks, or by implantation of the cut end of the ileum into the side of the colon with separate closure of the cut end of the colon. The latter is the method of choice, as being possible of accomplishment with comparative speed and ease, while it restores the natural relation of the small to the large intestine. The methods of circular enterorrhaphy have been described elsewhere (pages 326 and 331); it remains only to describe here the method peculiar to the region, that of lateral implantation.

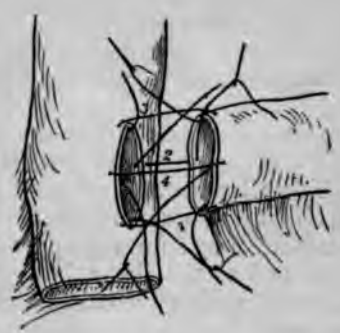
Lateral Implantation.—In the wall of the free distal end of the colon, at a point opposite the attachment of the mesocolon and beginning about one inch above its cut edge, make a longitudinal incision, in length slightly less than the diameter of the ileum; through the cut edge of the bowel at the upper and lower angle of this incision, and midway of each border, insert a silk suture, passing the needle from within outward; approximate the cut end of the ileum to this lateral incision in the colon, and first carry the needle, armed with the thread piercing the lower angle of the colon-wound, through the edge of the ileum at its mesenteric border; tie this, and pass the long ends of the suture into the cavity of the colon and out at its cut end: this can be readily accomplished by first passing the jaws of an hæmostatic forceps up through the open end of the colon and out through the lateral incision, so as to grasp the suture ends and draw them down and out below. Fig. 276, 1, shows this suture inserted and about to be tied.

The suture at the mid-posterior border of the colon-wound is next applied to the mid-posterior portion of the edge of the ileum, tied, and its loose ends carried into the colon and out below, as in the previous case; then the upper angle and the anterior borders are in succession sutured in the same way. Fig. 277 shows the first three sutures tied and the ends of the thread brought out through the open end of the colon. The fourth suture is about to be tied; the hæmostat is to be thrust up from below and out between the applied gut-edges, so as to seize the ends of this fourth suture and draw them into the lumen of the colon and out below with the others.

Invagination of the opposed edges of the ileum and colon and their projection through the open end of the colon is next produced by traction on the sutures and turning back the cuff-like borders of the open end of the colon, as shown in Fig. 278. By this means the entire cir-

cuit of the edges to be united is brought plainly into view, and is perfectly accessible for the careful completion of the suturing. The cut edges are already divided into four parts by the primary traction-sutures, and the danger of undue relaxation or tension of the parts is guarded against. The pouting edges are now carefully sutured together with a series of interrupted sutures of silk (preferably impregnated with paraffin to render them less absorbent). These sutures, placed about one-sixth of an inch apart, should include the entire thickness of the wall of the bowel, which they should

FIG. 276.

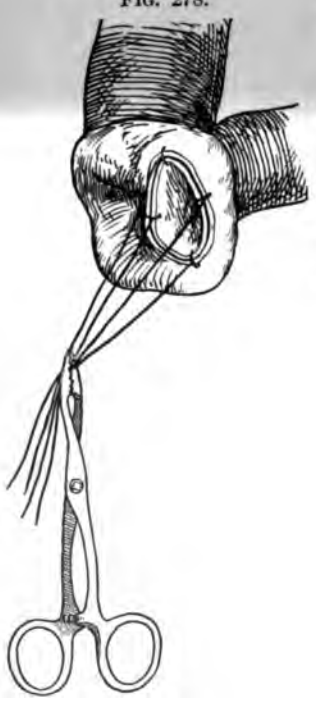


Lateral implantation of the ileum into the colon; four primary sutures, involving whole thickness of bowel-wall, applied, but not tied: first step of the suture. The figures indicate the order of tying the sutures.

FIG. 277.

Lateral implantation of ileum into colon, second step, tying of the primary sutures: the long ends of the threads carried into the lumen of the colon, and brought out below through the open cut end: fourth suture about to be tied.

FIG. 278.



Lateral implantation of ileum into colon, third step. Invagination of ileo-colic suture-line and exposure at the open end of the colon, ready for the application of the definite sutures.

FIG. 279.

Lateral implantation of ileum into colon, fourth step. The ileo-colic suture line returned to its proper place and reinforced by a series of sero-serous sutures; the open end of the colon closed.

pierce about an eighth of an inch from the edge. The knots all come inside of the bowel. As soon as these sutures are all tied the ends should be cut close and the invagination reduced. A series of sero-serous sutures should now be placed so as to reinforce the primary line of sutures. The application of these sutures will be facilitated by the insertion of the finger through the open end of the colon and the supporting on its tip of the point to be sutured. The ileo-colic suture having in this way been satisfactorily completed, the open end of the colon is now closed by a rapidly-applied running overhand stitch traversing its entire thickness, after which the suture-line is inverted and covered in by a row of sero-serous sutures. The condition as finally completed is shown in Fig. 279.

The temporary iodoform-gauze ligatures are now removed, and the fecal current is permitted to pass along the site of the suture. Careful watch should be made to detect any point of leakage. If any such point should appear, it should be closed by additional sero-serous sutures. The security of the suture-line having been fully tested, and appearing to be perfect, the bowel, after being well washed with a warm saline solution, should be replaced in the abdominal cavity.

Should threatening collapse of the patient make it best to desist from further operative interference—a contingency always to be apprehended in these cases—the great object of removing the intestinal obstruction will now have been gained, and that is often the most that can be hoped for. Possibly in some cases it might be possible after some days to resume the attempt to extirpate the growth. Should the operation have to be abruptly terminated at this stage, the cut ends of the diseased segment should be brought up into the parietal wound and secured there by appropriate suturing.

If the condition of the patient warrant it, the diseased segment should, however, now be removed. This can be done carefully and systematically, since it is no longer a part of the intestinal tract. The pelvis of the patient should first be elevated (the posture of Trendelenburg), and turned partially upon the left side, so as to secure gravitation of the intestines away from the field of operation and full exposure of the parts to be attacked. The vessels of the mesentery will then be secured by a chain of ligatures, and the gut separated from the mesentery by successive cuts as each portion of the mesentery is tied. This process is continued until the entire diseased segment has been separated and taken away. If infiltration into the adjacent parts exists, it must be excised if possible. Enlarged mesenteric glands should be enucleated, care being exercised not to interfere with any blood-vessels of supply to the sound intestine. Should any extensive glandular enlargement be detected, it would be useless to prolong the operation by attempting to remove any of them, for the diffusion of the disease beyond the possibility of complete removal is certain. The diseased parts having been removed and complete hæmostasis effected, the raw surfaces should be covered in with peritoneum as far as possible; the new ileo-cæcal suture line should be brought over to the vicinity of the parietal incision, and a fold of iodoform gauze should be laid under it and brought out at the lower end of the incision as a drain. This should be kept in place to guard against the dangers of possible fecal

leakage or incomplete aseptic technique during the operation. If at the end of four or five days no fecal discharge or septic infection has become apparent, the drain may be removed and the wound closed by a secondary suture. The general treatment of the patient should be simply that used after any severe abdominal operation.

Removal of Growths limited to the Colon.—According to the part of the colon involved, the primary incision through the abdominal wall may be made either in the middle line or in the right or left hypochondriac region, parallel with the costal arch and extending downward or inward as far as necessary to secure full exposure and ready access to the parts to be removed in the left lumbar and inguinal regions. If the growth appears to be so limited that it is susceptible of complete removal, its extirpation should be undertaken. The technique is similar to that already described for the removal of the ileo-cæcal portion. After the removal of the diseased segment the continuity of the intestine may be restored by a circular enterorrhaphy or by lateral anastomosis after closure by suture of the open ends. Anastomosis with the help of plates, decalcified bone or vegetable, is more rapidly accomplished than by the use of sutures alone. Whatever method is used should secure an opening between the two portions of the intestine of at least one and a half to two inches in diameter, for much subsequent contraction of the cicatricial borders is sure to occur.

If it is impossible to approximate the two ends of the intestine sufficiently to secure their union, then after they have both been closed, a loop of small intestine as near its junction with the cæcum as possible should be brought up by the side of the distal segment and a lateral anastomosis be effected. Senn's experiments have shown that a limited portion of the intestinal canal can thus be converted into a permanent cul-de-sac without risks from fecal accumulations in the excluded part, since by antiperistalsis the contents of the blind portion of the intestine are forced back into the active current of the intestinal circulation.

If the complete extirpation of the growth is found impracticable, the affected segment should be excluded from the intestinal circulation by an anastomosis as just described. In this case the intestine is not divided, but the loop of small intestine having been brought to the side of the colon distal to the growth, the anastomosis is accomplished while the field of operation is temporarily shut out from the fecal circulation by suitable ligatures placed around each portion of the intestine above and below the place of anastomosis.

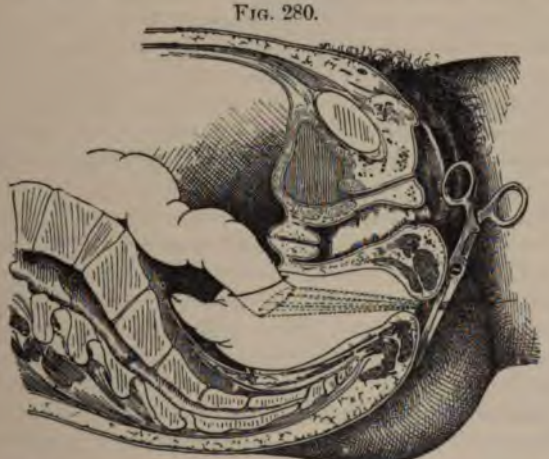
If the distal end is not sufficiently accessible to make an anastomosis possible, this end should be closed by suture and dropped back into the pelvis, and the proximal end be sutured into the external wound, making an artificial anus. The making of such an artificial anus, since it can be quickly accomplished, may often be all that it will be prudent to attempt at first, owing to the enfeebled condition of the patient. Should the strength of the patient thereafter sufficiently improve, a second operation may be resorted to for re-establishing the intestinal circulation.

In all cases of intestinal anastomosis where the communication is made in the lower portion of the colon or in the rectum the sphincters of the anus should be temporarily paralyzed by stretching (Senn).

Telescopic Colo-rectostomy.—When the growth is located in the lower part of the sigmoid flexure, the formation of an artificial anus may be avoided in some cases by implanting the proximal end of the colon into a lateral incision in the anterior face of the rectum, after the method of Kelly. For the accomplishment of this procedure the pelvic cavity must be exposed by a median incision through the abdominal wall from the symphysis to the umbilicus and by elevating the pelvis into the position of Trendelenburg. The growth should be excised if possible, and the distal or rectal end closed by suture. If the excision of the growth is impracticable, the colon should be divided above the growth and the distal end still closed by sutures. The sphincters of the anus should previously have been paralyzed by thorough over-distention and the rectum washed out by copious enemata.

Through the edges of the open proximal end of the colon are now passed six silk traction-threads, the ends of which are left long, about ten inches, being a convenient length for each end. A pair of long-handled artery-forceps or a sponge-holder is now thrust through the anus up the rectum until it makes prominent the anterior face of the bowel a couple of inches below the sutured ends or below the growth if this has not been removed. An inch-long incision is now made from the peritoneal side through the rectal wall, thus made prominent, through which opening the forceps is passed and made to grasp the traction-sutures already twisted into a bundle ready for it. As the forceps are now withdrawn into the rectum and out through the anus, the threads draw the end of the sigmoid portion into the rectal incision, thus telescoping the colon into

FIG. 280.



Section of pelvis, showing proximal end of sigmoid drawn into lateral incision in upper rectum, and held in place by forceps clamping the traction-sutures across the anus (Kelly).

the rectum to any degree that the surgeon may wish. The projection into the rectum should be at least half an inch. The peritoneal surfaces of the rectal incision are infolded by the entering colon and a wide circular band of apposed serosa created. If possible, the anastomosis should be fixed by a few sero-serous sutures applied from the pelvic side, but if this be impossible, fecal extravasation may still be escaped and recovery

assured by the wide and close apposition of the serous surfaces already secured. The traction-sutures should already have been brought out through the anus, and having been drawn taut enough to keep up sufficient traction upon the end of the colon to prevent its slipping back into the pelvis, they are secured by being grasped in the heel of the bite of the forceps lying across the anus in the gluteal furrow. (See Fig. 280.)

The pelvis should now be washed out with a warm saline solution, and an iodoform gauze packing inserted around the colo-rectal junction and brought out at the lower angle of the incision, to guard against any fecal extravasation. The greater part of the parietal wound is now sutured. If after four or five days no evidence of escape of fecal matter appears, this drain may be removed and the wound entirely closed.

Upper and Middle Portions of the Rectum.—The possibility of the successful removal of growths involving this portion of the intestine is also of very recent demonstration. Previous to 1874 the operable field of the rectum had been restricted to that portion of its course situated below the recto-vesical or uterine reflexion of the peritoneum. In that year Kocher of Berne published a method which he called his "long posterior incision," which included excision of the coccyx and exposure and enucleation of the diseased rectum, with free opening of the peritoneal cavity, when necessary, from behind and from above downward through this long incision. In 1892 his assistant, Arnd, was able to publish details of 17 patients operated upon by the "long posterior incision" in Kocher's clinic, 12 of whom recovered from the operation, and 9 of these remained well, free from recurrence, when seen at periods of from four to sixteen years later. The height to which the enucleation of the rectum could be readily carried was still more increased when Kraske in 1885[1] demonstrated that the lower portion of the sacrum up to the level of the third sacral foramen could be excised without injuring any important structure or entailing any serious disability. The partial resection of the sacrum gives such free access to the pelvic cavity that the entire rectum and the lower portion of the sigmoid flexure of the colon can be reached, freed from attachments, and removed with precision. In the operation of Kraske, after the soft parts have been divided in the middle line by a vertical incision extending from the second sacral spine to the anus, the coccyx and the left lower half of the sacrum were denuded, the coccyx was excised, the sacro-sciatic ligaments were divided, and the left margin of the sacrum was chiselled off on a line beginning at the level of the third sacral foramen, extending in a curve concave to the left, running along the lower border of the third foramen, through or beyond the fourth foramen to the left lower corner. The amount of bone removed is shown in Fig. 281 by the line *a*, *b*, *c*.

The removal of yet more of the sacrum was suggested by Kraske as permissible when required, and has been systematically worked out by other operators, as Hochenegg[2] and Bardenheuer.[3] Any division of the bone as high as the third sacral foramen has been found to be attended with risk of permanent paralysis of the bladder, and the lower border of this foramen has therefore become accepted as the highest limit to which it is justifiable to carry the resection.

[1] *Archiv f. klinische Chir.*, vol. xxxiii. p. 563.
[2] *Wiener klin. Woch.*, 1889, Nos. 26–30. [3] *Volkmann's klin. Vortrage*, No. 298.

Various osteoplastic methods in which the separated portion of the bone should be preserved in their attachments to the overlying flaps of soft tissue, and should be replaced after the resection of the intestine has

FIG. 281.

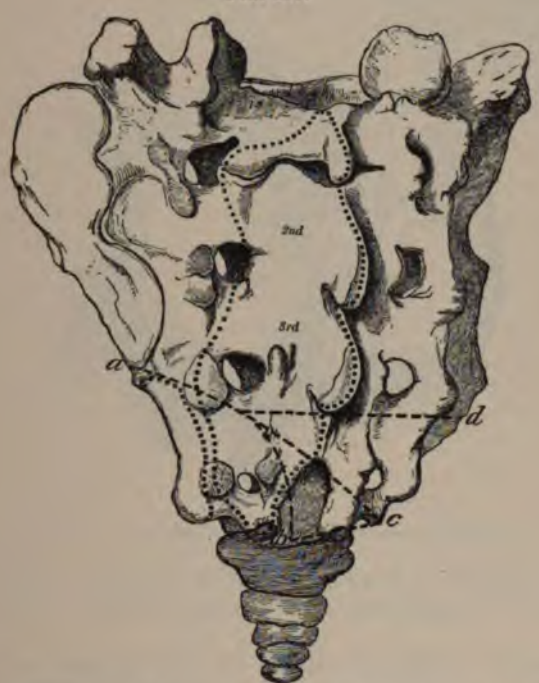


Diagram showing various proposed lines of the division of the sacrum: *abc*, Kraske; *ac*, Hochenegg; *ad*, Bardenheuer, Levy, Rydygier, *et al.*

been accomplished, have been practised (Heinecke,[1] Levy,[2] Rehn,[3] Rydygier,[4] Billroth,[5] Kammerer,[6] Borelius[7]).

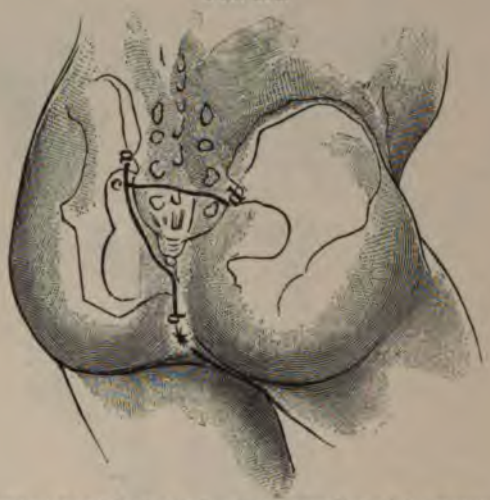
In many instances this has been found both feasible and advantageous, taking less time, entailing less loss of blood, diminishing the dangers of permanent fecal fistula, and securing a more complete subsequent restoration of the parts to their natural condition. The experience which has now accumulated indicates that, as a rule, the operation should be planned at the outset on the lines of osteoplastic resection: if in the course of the operation the needed access to the intestine is found to be seriously hampered by the presence of the bone in the flap, it should be unhesitatingly entirely removed.

In the methods of Rehn and Rydygier a long parasacral oblique incision through the soft parts along the left border of the sacrum and coccyx nearly to the anus is made: then a transverse incision across the sacrum about two fingers' breadth above the sacro-coccygeal articulation,

[1] Heinecke, *Münchener med. Wochenschrift*, 1888, No. 37.
[2] Levy, *Centralbl. f. Chir.*, 1889, No. 13. [3] Rehn, *Verhandl. Deut. Kong. f. Chir.*, 1890.
[4] Rydygier, *Centralblatt f. Chir.*, 1893, No. 1. [5] Foderl, *Wiener klin. Woch.*, 1894, p. 251.
[6] Kammerer, *Med. Record*, 1894, vol. xlvi. No. 14, p. 97.
[7] Borelius, *Centralblatt für Chir.*, 1895, p. 59.

along which the sacrum is divided with a chisel, the soft parts in front of the bone having previously been bluntly detached. The flap thus formed is turned to the right, on which side its attachments remain intact. Fig. 282 is a reproduction of the original diagram of Rydygier

FIG. 282.



Rydygier's method of osteoplastic resection of the sacrum.

to illustrate the incision lines made in this procedure. This method has been especially commended in the United States by Kammerer and Gerster.

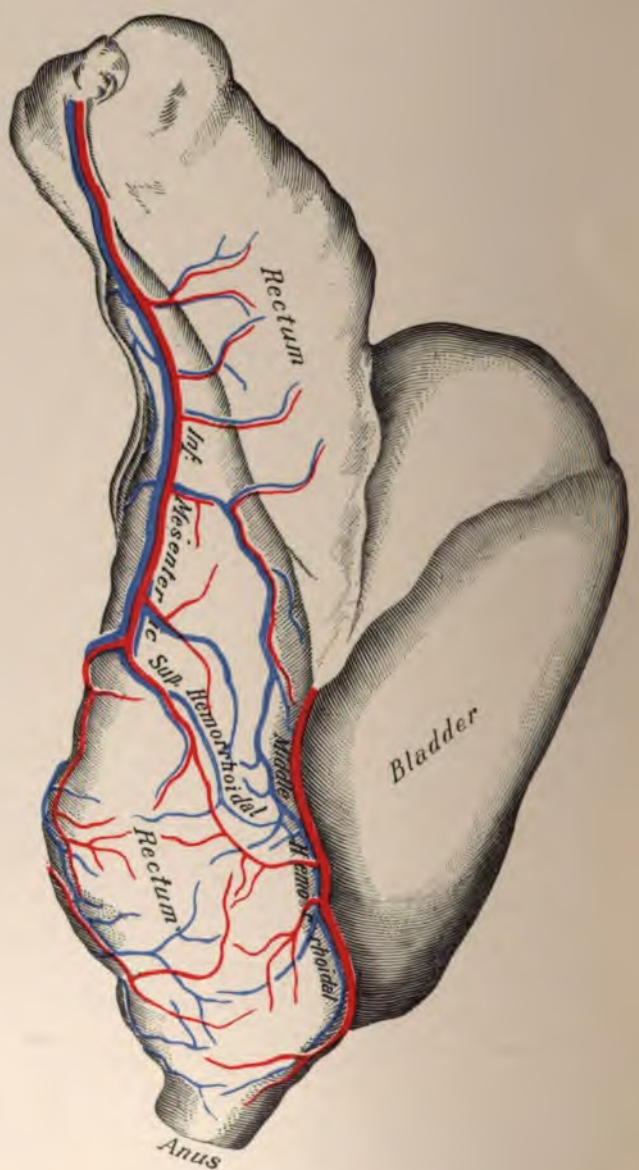
The feasibility of attempts at resection of the upper and middle portions of the rectum depends upon—(1) freedom of access to the pelvic cavity by sufficient resection of its posterior bony wall; (2) such division of the peritoneal reflections that constitute the mesorectum as will permit the free descent of the upper rectum and the adjacent colon; (3) preservation of the arterial supply to the proximal segment of the divided intestine; (4) protection of the peritoneal cavity from infection. The best ultimate results require also (5) the restoration of the natural fecal channel by union between the two segments of intestine; (6) preservation of the functions of the sphincters; (7) restoration of the bony framework of the pelvis; (8) prevention of later cicatricial stricture.

FIG. 283.

Mesial vertical section of pelvis (Braune).

Fig. 283 (after Braune), taken from a vertical section of a frozen cadaver, shows the relative position of the sacrum and coccyx to the rectum and to the peritoneal reflections when the rectum and bladder are moderately distended. The recto-vesical peritoneal reflec-

PLATE V.

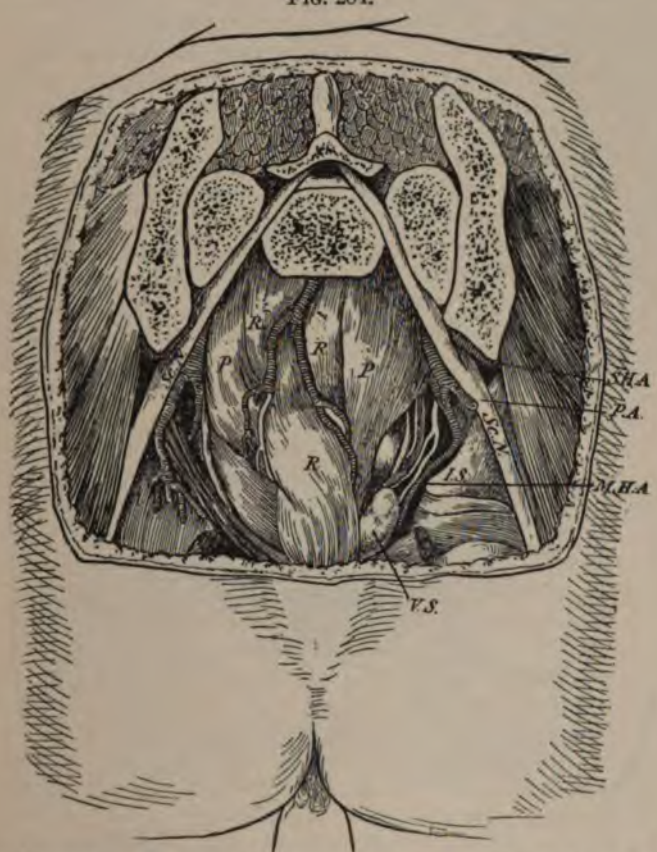


Postero-lateral View of the Dilated Bladder and Rectum in the Male (from a dissection by the author).

tion in the male is usually about three inches (5 to 6 cm.) from the anus when the bladder is empty: distention of the bladder will increase the distance nearly an inch more. The point of the coccyx descends below the level of the recto-vesical peritoneal fold.

The envelopment of the rectum by the peritoneum becomes rapidly more extensive as it ascends, until at the level of the third sacral vertebra it is nearly complete, and an appreciable mesorectum is formed which merges into the mesocolon above. The oblique line of this

FIG. 284.



Relations of the rectum after removal of sacrum and coccyx (after Quénu and Hartmann): *R, R, R*, rectum; *P, P*, peritoneum; *S,H,A*, superior hemorrhoidal artery; *P, A*, pudic artery; *M, H, A*, middle hemorrhoidal artery; *V, S*, vesiculæ seminales; *I, S*, ischial spine; *Sc. N*, sciatic nerve.

peritoneal reflection is well shown in Plate V. The posterior face of the rectum not covered by peritoneum is separated from the anterior face of the sacrum and coccyx by a rather loose layer of connective tissue. Between the layers of the mesorectum in the mid-posterior line descends from above the inferior mesenteric artery, which divides into the two superior hemorrhoidal arteries where the mesorectum terminates (Fig. 284 and Plate V.). An important surgical point in connec-

tion with these vessels is that they run close to the muscular tunic of the intestine, and may be readily stripped up with the intestine, and that the lateral peritoneal reflections which bind down the intestine can be readily incised without wounding the vessels if care be taken to keep the point of the scissors in the loose connective tissue immediately underneath the peritoneum. By observing precautions not to wound these vessels the upper part of the rectum can be loosened freely from its attachments to the pelvic wall without endangering its nutrition. On the other hand, if these vessels are cut at a point some distance from the end of the intestine which has been subjected to resection, a more or less extensive necrosis of that end will occur (Plate V.).

Further, it is evident that in enucleating the rectum the investing connective tissue should not be too closely stripped from its muscular tunic, but should be divided along a plane outside of the vessels. The terminal branches of the superior hemorrhoidal artery descend externally to the muscular coat to within about three inches of the anus: at this level they pass into the submucous coat to anastomose with the twigs of the middle and inferior hemorrhoidal arteries.

The attachment of the levator ani muscle may be considered as the lower limit of the intrapelvic portion of the rectum. This muscle is practically a musculo-fibrous diaphragm which closes the inferior outlet of the pelvis. The rectum, as it passes through it, affords a surface for the attachment of its strongest and best-developed fasciculi. Fig. 285

FIG. 285.

Transverse vertical section of the pelvis, passing through the anus (Quénu and Hartmann): *R*, anterior curvature of the rectum; *P*, peritoneum; *lev. ani*, levator ani muscle; *Sph*, sphincter.

(after Quénu and Hartmann) represents a transverse vertical section of the pelvis, passing through the anus. The manner in which the fibres of the levator ani, springing on either side from the ischial spines, form a barrier between the cavity of the pelvis and the superficial parts, is plainly depicted. The upper face of the muscle is covered by peritoneum, the lower face forms the roof of the ischio-rectal fossa. The portion of the rectum below the insertion of the muscle into it is within the grasp of the sphincters, constitutes its outlet, and is a part of the

anus. Surrounded by the loose adipose connective tissue of the ischio-rectal space, with an independent vascular and nervous supply, this terminal portion of the rectum forms a superficial structure that is entirely distinct in its surgical relations from that portion which is above the levator.

The anterior face of the rectum in the male, below the reflection of the peritoneum upon the bladder, is separated from the base of the bladder and from the lower surface of the prostate by a layer of connective tissue—the prostato-peritoneal aponeurosis. Beyond the borders of the prostate, above and laterally, the fibres of this aponeurosis are loosely interwoven and permit the ready stripping away of the rectum. Upon the prostate itself the fibres are more dense, but with care the rectum may still be readily separated from it. In the female the layer of connective tissue which separates the vagina from the rectum is quite loose and abundant.

The amount of division of the peritoneum which will be required in a given case must vary according to the height at which the growth is located and the extent of the bowel which is to be resected. In any case it should be sufficient to give such access to the diseased segment of the bowel as will facilitate the manipulation required for its removal, and will permit the proximal cut end to be drawn down without tension either to the distal end or into the external wound as the case may be. The peritoneal cavity is to be protected from infection—1st, by previous thorough cleansing of the bowel by copious irrigations after it has been emptied by laxatives: this cleansing of the bowel will be much facilitated if a preliminary colostomy has been made, by means of which the fecal current shall have been entirely diverted from the rectum and an opportunity for thorough irrigations of the obstructed rectum secured; 2d, by exercising care in the enucleation of the rectum not to tear through its walls. This will be the more certainly avoided, and its arterial supply at the same time preserved, if some thickness of the perirectal connective tissue is left between the plane of section and the muscular coat. If an accidental tear should occur, it should at once be sutured tightly and the parts disinfected before proceeding. When the rectum is sufficiently enucleated, the opening in the peritoneum and the adjacent wound-surfaces should be covered by sterilized gauze compresses; the rectum above the tumor should be encircled by two ligatures—narrow folds of iodoform gauze—placed about two inches apart. Between these the gut is now divided, the line of division being one inch or more above the apparent disease. The exposed mucous surfaces are then thoroughly irrigated with a boro-salicylic solution, after which the extirpation of the diseased segment is effected. After it has been cut away, if further division of the peritoneum is required to permit the desired descent of the proximal stump, it should be done, after which the opening in the peritoneum should be closed by careful suture. Later infection is guarded against by open treatment of the external wound and the use of iodoform-gauze packings.

The restoration of the natural fecal channel by uniting the upper and lower segments is to be secured if possible. In favorable cases it may be possible to freely invaginate the proximal end into the anal portion by a method similar to that used for invaginating the ileum into the colon for

lateral implantation (see page 475). The bowel-edges are first united at six or more points by sutures whose ends are left long and are pulled into the lower segment and out at the anus by forceps. Then by traction upon these threads the end of the upper segment is pulled into the lumen of the lower segment, whose wall is at the time infolded with it, so that a relatively broad surface of apposition between the denuded bowel-walls is secured. In some cases the end of the upper segment may even be made to protrude through the anus. In all cases these invagination-sutures should first be applied, and as much invagination be secured as may be without exerting much tension upon the upper portion of the intestine. The ease with which the two portions of the intestine may be approximated may be increased when needed by displacing the anus upward, after the method of Lange,[1] in which, by a curved incision in front of the anus from one tuberosity of the ischium to the other, penetrating as deep as the anterior fibres of the levator ani muscle, some of which are divided, the anus is separated from its perineal attachments, so that it may be displaced upward and backward to an extent of nearly two inches. When the amount of invagination which can be secured is not very great, the line of union should be strengthened by a row of additional sutures penetrating only the muscular and submucous coats.

The point cannot be too strongly emphasized that full relaxation of the bowel at the line of suture must be secured. Some later retraction of the upper segment is unavoidable, and the swelling and stiffening of the parts from inflammatory engorgement must be allowed for. Tension upon the suture-line by the passage of fecal masses must be absolutely avoided until firm cicatrization has been secured, otherwise fecal extravasation and fecal fistula will certainly result—a condition which experience has shown to be very difficult to overcome. The preliminary colotomy already advised has an additional value in preventing the descent of fæces to the point of suture until the surgeon may will it, and for this reason should be done whenever the possibility of such suture is appreciated. The sphincter should also be kept relaxed, either by over-distention or by incision, for at least one week, to prevent the accumulation of secretions within the rectum.

If, for any reason, a preliminary colostomy has not been done, no attempt at keeping the bowels constipated should be made, but, on the contrary, liquid stools should be secured by appropriate laxatives after the second day, previous relaxation of the sphincters having been effected.

When the invagination and suturing of the upper segment of the rectum to the lower has been so satisfactory that undisturbed union seems probable, the bone-flap is to be replaced in its proper position and secured by sutures through its periosteal and aponeurotic coverings. A gauze drain should be introduced at its side down to the suture line in the bowel. If the suturing has been evidently imperfect or necrosis of the upper segment of the bowel is feared, or it has been found impossible to remove the whole of the growth and to loosen and bring together for suture the two ends, no suture of the bone-flap should be attempted, but gauze tamponade of the wound-cavity should be made and the wound be allowed to granulate. Healing will be attended by some retraction of the flap and some deformity, but no serious functional weakness.

[1] *Annals of Surgery*, 1893, xvii. 227.

The contingency that has just been mentioned, that such extension of the growth beyond the bowel has taken place as to make impracticable its complete removal and subsequent approximation of the intestines, may become evident for the first time as the operation progresses. The best thing that can be done in such a case may be to bring the upper end of the cut bowel into the upper angle of the external operation-wound and establish an anus in the sacral region after total ablation of the detached fragment of the sacrum. If the inoperable nature of the growth had been appreciated earlier, no attack from the sacral region would be attempted, but an inguinal colotomy alone be resorted to.

Considerable contraction of the circular cicatrix of the intestine at the site of the suture is unavoidable. Treatment to prevent this as far as possible should be begun as early as the third week by the daily introduction of a full-sized soft-rubber bougie. Gradually the use of the bougie may be made less frequent, until after the lapse of a year its regular use may be discontinued.

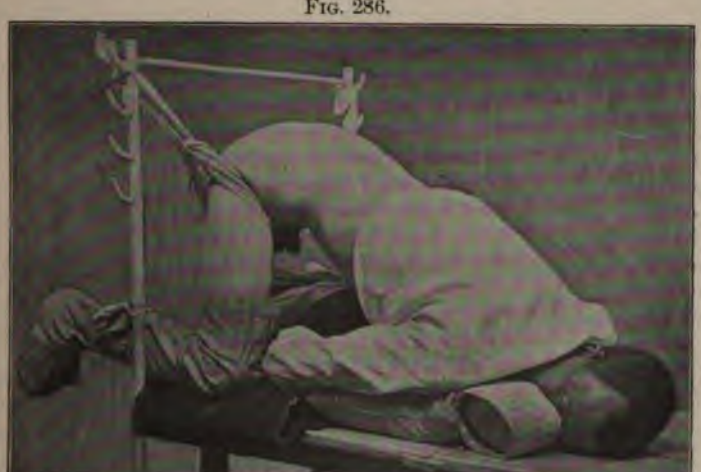
Technique.—After the foregoing discussion of the details of removal of high-lying rectal growth a brief *précis* of the operative technique will suffice:

1. *Preliminary colostomy* desirable in all cases; imperative when the obstructive and ulcerative symptoms are marked.

2. *Preliminary cleansing of the bowel* by laxatives and enemata, with additional profuse boro-salicylic irrigations after anæsthesia has been induced and the sphincters have been dilated.

3. *Decubitus.*—Best is the knee-chest posture, the pelvis being held in elevation by sand-bags under the iliac wings, together with perineal bands suspending it from suitable upright supports attached to the ope-

FIG. 286.



Method of securing elevation of pelvis for resection of the rectum.

rating table. This position lessens bleeding, gives excellent access to the field of operation, and facilitates manipulation within the rectum through the anus (Fig. 286). The right latero-prone position may also be used.

4. *Primary Incision.*—The incision of Rydygier (Fig. 285) should be used, and that method as already described (page 481) should be followed until the osteo-integumental flap has been turned aside and the deep field is well exposed by the strong retraction of the wound-edges.

5. *Hæmostasis.*—The prevention of hemorrhage is of the utmost importance: a marked tendency to bleeding from numerous small vessels in the dense fibrous layers that are cut is usually present; this is the more marked when the bone is wholly resected. This must be restrained by means of ligatures, clamps, and pressure at each step of the operation.

6. *Enucleation of the Rectum.*—An assistant should pass a small sponge upon a sponge-carrier through the anus and up into the rectum as far as the tumor, and by it press the posterior wall of the rectum up into the wound. The incision in the mid-line is then carefully deepened until the posterior wall of the rectum thus made prominent is well exposed. The further isolation of the rectum is effected by thrusting the fingers into the connective tissue on either side and tearing it apart throughout the whole length of the wound down to the attachment of the levator ani. This blunt dissection should be carried through the connective tissue outside the innermost layer in which the hemorrhoidal vessels run. The scissors and knife may be used as required to sever fibrous bands that require undue force to tear through. The rectum can thus be readily isolated from the base of the bladder or from the vagina, and with care may even be stripped away quite freely from the peritoneum above without wounding the latter. If it is necessary to continue this enucleation to any distance above the line of the peritoneal reflexion, it is better to open through the peritoneum at once and incise it on both sides on a line parallel with the long axis of the bowel, as far upward as may be necessary to permit the required descent of the bowel. The precautions, already discussed, required to avoid wounding the superior hemorrhoidal and inferior mesenteric arteries are to be observed in this division of the peritoneum. After the division of the peritoneum the attachments of the rectum to the anterior face of the sacrum are readily separated by the finger.

7. *Excision of the diseased segment.*

8. *Apposition and suture of the two segments.*

9. *Replacement of the bone-flap.*

10. *After-treatment.*

Each of these is to be carried out in accordance with the directions already given.

Artificially-produced Prolapse through Anus of High-lying Growths, and Excision.—Maunsell of New Zealand has proposed in cases of cancer of the upper two-thirds of the rectum and lower third of the sigmoid flexure, after thorough cleansing of the lower rectum and free division of the sphincter ani, to open the abdomen and freely divide on either side the lateral peritoneal reflections of the mesorectum, care being taken to keep the probe point of the blade of the angular scissors with which the division is made pressed upward and outward to avoid wounding the vessels, nerves, and lymphatics which course between the folds of the mesorectum. A piece of broad tape is then carried by a suitable long needle through the proximal side of the growth into the cavity of the rectum, first on one side and then on the other; the ends are seized

by forceps and drawn out through the anus. By drawing on this, if sufficiently free division of the rectal attachments above has been made, there is no obstacle to the invagination and complete prolapse of the upper three-fourths of the rectum out through the anus. The diseased segment, thus made accessible, can now be excised and careful suture made. Before returning the gut the colon should be washed out with warm boro-salicylic solution and all hardened masses of fæces removed. Then, after dusting the prolapsed surface with boracic acid and iodoform, the bowel is gently returned.

Mortality.—A considerable mortality must attend all of the methods of resection of the rectum, as well as of other portions of the large intestine. The anæsthesia and the operative manipulations are necessarily prolonged, the patient is enfeebled by his disease, unavoidable loss of blood greatly increases the shock of the operative traumatism, and the supervention of peritonitis and renal congestion is always to be feared. After resection of the rectum later fecal extravasation from necrosis of the rectal stump or from imperfect suturing or defective after-care, with consequent retroperitoneal septic infiltration and prolonged suppuration, may occur and lead to fatal exhaustion.

The statistics which are accessible in the literature of the subject are as yet scanty and of little value. As to operations upon the rectum, no distinction is made in the mortality statistics between the cases in which an excision and an amputation was done. The statistics of Kocher and Czerny may be mentioned. Kocher, out of 17 cases subjected to the Kraske operation, lost 5—that is, 30 per cent.; Czerny, out of 34 cases in which preliminary resection of the sacrum was done, lost 7—that is, 20 per cent.

The final results depend entirely upon the absence of metastases and upon the thoroughness of the local extirpation. The same conditions that affect the results after the removal of carcinoma in other parts of the body attend efforts for its removal from the rectum. The earlier the presence of the disease is detected and subjected to ablation, and the wider the zone of apparently healthy tissue about the growth that is removed, and the more careful and extensive the search for and removal of infected glands that is made, the greater will be the probability of subsequent freedom from recurrence and of absolute cure. Of the 12 operative recoveries reported by Kocher, 9 (75 per cent.) were alive and free from recurrence when examined from four to sixteen years after operation; of the 27 recoveries reported by Czerny, 18 (62 per cent.) were still alive and free from recurrence at the time of report: in 6 of these the period since the operation was more than two years.

Lower Third of the Rectum.—Carcinoma affecting any portion of the lower three inches of the rectum demands amputation of the intestine at a point at least one inch above the apparent upper margin of the growth, with wide and free excision of the circumrectal and circumanal tissues that are still apparently sound. The farther away from the grossly appreciable disease that the line of extirpation can be carried the greater the security against recurrence. If in the male the prostate is involved, it should be freely excised; the bladder and the ureters, as a rule, are involved at a very late date, and that indirectly through the prostate. No hesitancy should be felt in resecting a portion of the

bladder with the prostate if necessary in order to get well beyond the bounds of the disease. If in the female the recto-vaginal septum is involved, free incision of it should be done. The bladder or vaginal defects after such incision may be immediately closed, wholly or in part, by such plastic suturing as the condition of the parts may admit.

So long as the rectal tumor is movable and has not invaded the pelvic wall it should be removed. The most favorable cases for extirpation are naturally those in which neither prostate nor vagina has become involved, but in which the growth is confined to the posterior wall of the rectum, or, arising from the anal verge, has not yet widely infiltrated the ischio-rectal space, and whose borders can be well defined by the finger, while the wall of the intestine is still movable on the subjacent tissues.

The preparation of the patient for the operation should be the same as that already prescribed for the removal of higher-lying growths. The preliminary colotomy is not so essential. An exaggerated lithotomy position will be found to be a convenient position in which to place the patient as long as the growth is at the outlet of the rectum; the knee-breast position is, however, still the most favorable for the ready access to the parts for the free excision that should be made.

The operation should begin with the long posterior incision of Kocher and removal of the coccyx: if in the progress of the enucleation of the rectum it should be manifest that the disease extended upward to a point that could not be readily handled through this incision, a transverse incision should be added across the middle of the sacrum; the sacrum should be divided transversely below the third foramen, and temporarily turned to the right, as in the method of Rydygier. Anteriorly the incision should be made to circumscribe the anus and extend into the perineum, but this extension of the incision should be deferred until in the course of the enucleation from above this part is reached, for thereby the tendency to hemorrhage can be more readily controlled.

The enucleation of the rectum and its division are to be conducted as already described: many growths may be removed without opening the peritoneum, but the operator should not permit himself to be embarrassed in his manipulations nor refrain from the required free extirpation of the tissue surrounding the growth through desire to preserve the peritoneum intact. The direction of the operative attack should always be from above: after the rectum has been divided transversely the lower portion with the diseased tissue is to be pulled down and dissected out, the field of work becoming constantly more broadly accessible; the peritoneal reflection, the base of the bladder, and the prostate or the recto-vaginal septum are in succession exposed; the vessels cut are a few larger trunks that are at once seen and tied or clamped; the full extent of the advance of the growth is more perfectly appreciated, and the steps necessary to its full removal can be taken deliberately and with precision in a clearly open field. In the male, if the bladder is distended with air, as recommended by Bristow for suprapubic cystotomy, the line of the peritoneal reflection will be lifted at least one inch; the base of the bladder will be made prominent and tense, and thus its enucleation facilitated.

If the disease plainly does not involve the anus, and section can be

carried through healthy tissue above the sphincters, these should be carefully preserved, provided their nervous supply is intact, and an attempt be made later to bring down the proximal rectal stump through them. Plainly, there can be no advantage in preserving a paralyzed muscular ring. No risks of leaving behind diseased tissue should be incurred for the sake of preserving the sphincters.

The treatment of the stump of the rectum may vary. If the peritoneum has been opened it will usually be possible to so free the rectum from its upper attachments as to permit its end to be drawn down to the margins of the skin-wound in the perineum, where it should be fixed by suitable suturing: if the coccyx has been excised, whether the peritoneum has been opened or not, it may be more convenient to bring out the rectum in its site, thus displacing the anus backward and upward. Previous to the suturing of the rectal opening to the skin the deeper recesses of the wound should be closed as much as possible by buried catgut sutures, and any osteo-integumental flap should be replaced and secured by appropriate sutures; the primary suture of the external wound should be partial only, a free outlet being left for the escape of wound-discharges, while down to the bottom of all wound-spaces, especially on either side of the intestine, should be carried strands of iodoform-gauze. If serious difficulty be met in bringing down the end of the rectum, or the condition of the patient demand that the operation be abruptly closed, all suturing may be refrained from and the wound left entirely open to granulate. In such cases the cicatricial stenosis that follows as the wound heals must be met by systematic bougie dilatation, begun as early as the third week and kept up for a year or more. An abundant absorbent and protective dressing should finally be applied and kept in place by a diaper.

It is desirable that the escape of fæces should be retarded as long as possible after the operation. The diet should therefore be carefully regulated, so as to leave as little solid residue as possible, and peristalsis should be checked by moderate doses of opium.

If a preliminary colostomy has been made, all the disturbances that may be caused by smearing the wound-recesses with fæces will be avoided.

The mortality caused by removal of the lower portion of the rectum is small when adequate provision has been made to control hemorrhage and to avoid peritoneal infection during the operation, and in the later progress of the wound to secure perfect drainage. The great mortality and the lack of radical benefit that attended the earlier operations that were made after the publication of Lisfranc's observations in 1830 caused this procedure to fall into disrepute, but the better technique, the wiser selection of cases, and the more exact appreciation of the indications for operation that have marked the work of the most recent surgeons have fully established the operation as a reasonably safe and valuable procedure. Unavoidable loss of blood, often quite great even with every precaution, and the effects of prolonged anæsthesia, will, in certain cases of enfeebled patients and in those prone to pulmonary and renal congestion, be followed by death as the immediate effect of the operation. The nature of the disease, however, abundantly justifies the surgeon in taking any risk as long as there is a reasonable probability

that thereby the disease may be wholly eradicated. Cripps in 1892 was able to report 38 cases of extirpation of the lower third of the rectum, with 3 operative deaths (8 per cent.); in 1888, König reported 60 cases, with 6 deaths (10 per cent.); up to 1889, Krönlein out of 22 operations had 2 deaths (9 per cent.); in 1892, 32 cases were reported from Czerny's clinic, with only 1 death (3 per cent.); Kelsey[1] out of 13 operations in the year immediately preceding his report had 1 death (7.7 per cent.). These results indicate that under the best conditions a death-rate of from 5 to 10 per cent. may be expected to attach to the operation.

Remote Results.—Whether or no complete cure is secured by the extirpation of a cancerous rectum will depend on the same conditions that influence the results of operations for carcinoma in other parts of the body. Unfortunately, a large proportion of cases are not seen until the disease has spread along the lymph-paths to distant parts, or has involved adjacent organs to such a degree as to be manifestly inoperable. In cases that are still so localized as to permit of entire removal the surgeon may fail to carry his extirpation sufficiently wide of the grossly-affected tissue, and as a result local recurrence may speedily follow, which would not have occurred had wider removal of tissue been made in the first place; it is impossible, therefore, to present any general statistics that are of any value. Such results as those published by Cripps and Czerny contain much encouragement, and suggest the hope of yet better results in the future as still more radical and earlier extirpations are adopted. Cripps had been able to trace the subsequent history of 28 of his cases: in 15 of these recurrence had taken place, 1 died of other disease, and 12 were living at the time of the report without recurrence, of whom 7 had passed the limit of three years since the operation. Of 30 patients operated upon by Czerny from the perineum in the course of six years, 16 died from recurrence after an average life, *post-operationem*, of two years; 10 remained alive and well at the time of the report. The literature of the subject contains accounts of many other cases of prolongation of life for many years after extirpation of rectal carcinoma without recurrence of the disease.

The further progress of the disease after incomplete extirpation may be as a growth in the scar at the new anus. If early detected, renewed extirpation may still be undertaken with possibility of radical cure. Even if no further rectal disease manifests itself, disease of the pelvic glands may after a time become apparent, attended with manifestations of metastatic growths in the abdominal organs, especially the liver. Such internal growths are attended with but little pain. Since by the removal of the primary disease much of the suffering that attends the unchecked progress of cancer of the rectum is prevented, the operation has therefore also a distinct value as a palliative procedure even in the cases where it is not followed by a permanent cure. In this respect it is to be compared with colostomy, which in some cases may be substituted for it, especially when the disease is seated in the upper two-thirds of the rectum.

Fecal incontinence is unavoidable when the sphincters are removed or are paralyzed. A relative continence may become established after a time by hypertrophy of the circular fibres at the rectal outlet and by

[1] *New York Medical Journal*, Oct. 12, 1895.

cicatricial contraction, and the inconveniences of the loss of the sphincter may be somewhat lessened by suitable compresses and by care in diet. The ability to hold back flatus will, however, not be regained, and in diarrhœal attacks the patient is helpless.

As a substitute for the lost sphincter it has been suggested that the end of the rectum be carried to one side and brought out through the gluteus maximus muscle.[1] Good functional results from this procedure have been reported.[2] A simpler device is that of Gersuny, who twisted the free portion of the rectal stump upon its own axis, and thus created at the new anal outlet such a degree of elastic resistance to the escape of the rectal contents as to be a fair substitute for the lost sphincter. The method is as follows: The stump of the rectum, being sufficiently free so that it can be easily drawn down to the skin-surface, is seized by two clamps placed on its free end diametrically opposite each other, and by these twisted on its long axis from 180° to 270°—that is, until the finger introduced into the lumen of the intestine appreciates that its passage is met by considerable resistance. The gut, so twisted, is then sutured by its free end to the skin. Perfect control over the bowel is stated by Gersuny to have been regained by patients in whom this procedure had been used. Gerster[3] confirms the claim of Gersuny. Should the amount of torsion originally applied be found not to have secured the desired full amount of control over the bowel, it would be practicable at a later date to loosen up the lower end of the rectum for two or three inches and twist it to a greater degree.

The tendency to stricture from cicatricial contraction at the anal outlet when the bowel-stump has not been sutured to the skin has already been commented upon. According to Cripps, this tendency to contraction gradually disappears under systematic dilatation and gives little trouble after the second year.

Prolapse of the rectal mucosa is a relatively frequent occurrence when the new anal orifice is patulous, especially when it has been displaced upward near the sacrum. When this prolapse is troublesome, the protruding mucous membrane may be excised or the loose bowel be drawn up and secured by sutures to the anterior abdominal wall through a suprapubic incision.

(*b*) *Growth Diffused or Complicated by Metastases.*—When upon examination it is evident that the perirectal tissues are infiltrated by the growth, or bimanual exploration of the pelvis and abdomen reveals post-peritoneal nodules, or enlargement of the liver is detected, or the age and manifest feebleness of the patient are such as to make attempts at the operative removal extra hazardous, hope of radical extirpation must be abandoned, and surgical effort be directed simply to palliation of the sufferings of the patient. Opiates should be given as freely as required to relieve pain and secure some degree of comfort. Such laxative regimen and medication should be employed as will keep the fecal discharges liquid and prevent the accumulation of solid matter above the growth. The sanious acrid discharges generated by the breaking down of the growth should be washed away by frequent injections of mild antiseptic solutions; anal excoriations should be alleviated by the free use of oxide

[1] Willems, *Centralblatt für Chirurgie*, 1893, No. 19.
[2] Witzel, *ibid.*, 1894, No. 40.
[3] *Annals of Surgery*, 1894, xix. 612.

of zinc in ointment or powder: if the growth is near the anus, the patency of the bowel may be promoted by the occasional careful introduction of a finger or a soft bougie or by curetting away portions of the fungating mass.

Colostomy—Artificial Anus.—Whenever marked obstructive symptoms exist, notwithstanding the use of laxatives and enemata, or whenever the flow of fecal matter along the diseased rectum is a source of material suffering and exhaustion to the patient, a new fecal outlet should be established by a colostomy, so as to entirely divert the fecal current from the seat of the disease. It will often occur that a patient will not come under the care of the surgeon until urgent obstructive symptoms have already developed, in which case the necessity for immediate colostomy is unquestionable. The establishment of an artificial anus is, however, not to be regarded as a *dernier ressort*, justifiable only in extreme conditions, but as a valuable palliative procedure to be resorted to as a therapeutic measure as soon as it is evident that by its performance pain can be relieved, suffering can be prevented, and a source of local irritation can be removed. When done early and in the absence of conditions of obstruction or of great enfeeblement it entails little risk of life: the disagreeable features that are inevitable to an artificial anus may usually be kept under such control that a considerable degree of comfort and of activity may for a long time be enjoyed by the patient.

The establishment of an artificial anus by a left inguinal colotomy, first suggested by Littré in 1710, was first done in 1776 by Pillore. From time to time thereafter it was done by others with varying success, until, after the publication of Amussat's memoir in 1835, it was superseded by the operation in the lumbar region, which had been proposed as early as 1796 by Callisen. Through a lumbar incision the colon may often be reached and opened without wounding the peritoneum. This possibility controlled the choice of the route to be adopted as long as serious hazards attended peritoneal wounds. At the present time the mere opening of the peritoneum with proper precautions has in itself such little significance that it need not influence the surgeon in his choice of a point for the establishment of an artificial anus. As compared with the inguinal site, the lumbar site has these disadvantages: there is necessarily a greater operative traumatism; there is a more extensive opening up of connective-tissue spaces and a greater tendency to subsequent diffuse infective cellulitis; there is greater difficulty in identifying the bowel sought; it is much less easy, often impracticable, to so draw the bowel out through the external wound as to thereafter entirely prevent the access of fecal matter to the lower segment; no opportunity for the exploration of pelvis and abdomen is possible during the operation; and, lastly, the site of the artificial anus is less convenient for the after personal attention of the patient. For these reasons the lumbar route has ceased to be the method of choice, except, possibly, in cases in which by prolonged obstruction the distention of the colon has become extreme and its immediate opening is imperative. In such a case the exposure of the distended gut through an extraperitoneal opening in the loin is more readily effected than when it is not so distended, and its immediate incision is less likely to be attended with peritoneal

infection. Also when, after the inguinal opening has been made, the colon is found to be so bound down to the posterior wall of the abdomen that it cannot be readily brought up into the opening in the anterior wall, it should be approached and opened through a second incision in the loin, unless the descending colon itself should appear to be manifestly diseased, in which case an anterior transverse or right iliac colostomy should be substituted.

Technique of Iliac Colostomy.—The abdominal cavity is opened by an oblique incision running in the direction of the fibres of the external oblique muscle, distant about one and a half inches from the anterior superior spine of the ilium, and having its mid-point upon a line drawn from that spine to the umbilicus. (See Fig. 287.) In making this incision the fibres of the external oblique when exposed should be bluntly separated and strongly retracted, so as to widely expose the surface of the internal oblique. The fibres of the latter muscle should then be bluntly separated and retracted, so as to expose the fibres of the transversalis, which are in turn bluntly separated and strongly retracted; the transversalis fascia and the peritoneum are lastly incised in the line of the separation of the fibres of the transversalis muscle. The length of the peritoneal cut should be about two inches, and that of the primary skin-incision will have been three or four inches, according to the thickness of the abdominal wall. By thus abstaining from transverse division of any portion of the abdominal musculature a certain amount of voluntary control over the artificial anus may possibly be secured. This procedure is readily effected when the abdominal walls are thin and relaxed. Whenever the abdominal walls are found to be too thick or too tense for the easy performance of the successive retractions of the different layers, these layers should be unhesitatingly divided by the knife in the line of the skin-incision. As the peritoneum is cut, if a clamp-forceps be placed upon either edge of the resulting wound further manipulations will be much facilitated. The finger should be introduced through the wound into the peritoneal cavity, and such exploration made as may be necessary to secure a clear knowledge of the state of the walls of the rectum, of the sigmoid flexure, and of the lymphatic nodes. As the finger is withdrawn, it should hook up and bring out through the wound the colon, which will be recognized by its anatomical peculiarities—*i. e.* longitudinal bands, sacculated wall, and epiploic appendages. Traction should now be made upon the colon, and portion after portion of it pulled down and out of the wound, until a part is reached whose further extension is arrested by the shortness of the mesocolon. As each portion is pulled out the portion already out is pushed back. Care must be exercised that in this

FIG. 287.

Parietal incision for left iliac colostomy.

procedure the direction of the traction upon the bowel is successively upward toward the descending colon, for the sigmoid loop is often twisted, so that the upper part of the knuckle presenting in the wound leads to the rectum. The finger should therefore in all cases be again introduced into the wound after the first loop of bowel has been brought out, and should follow the direction of the mesocolon sufficiently to ascertain accurately the course of the bowel. The object of this drawing down of the colon is to prevent subsequent prolapse of the bowel through the artificial anus. The protruding knuckle of the colon is now pulled out sufficiently to expose the attachments of its mesocolon, and through this, close to the bowel, is thrust a small sterilized rod four or more inches in length, of glass, hard rubber, or metal as may be most convenient. By resting this rod on the edges of the parietal wound the retraction of the bowel is prevented, and the protrusion of the posterior wall of the bowel as a spur, after the anterior wall has been cut away, is assured. After the rod has been passed through, the intestine should be lifted out a little upon it, and a couple of sero-muscular sutures on each side of the mesocolon should fasten together the surfaces of the two limbs of the flexed intestine that fall together below the rod. (See Fig.

FIG. 288.

Iliac colostomy; formation of the spur by rod and sero-muscular sutures: *A*, transverse section of the supporting rod; *B*, the sero-muscular sutures.

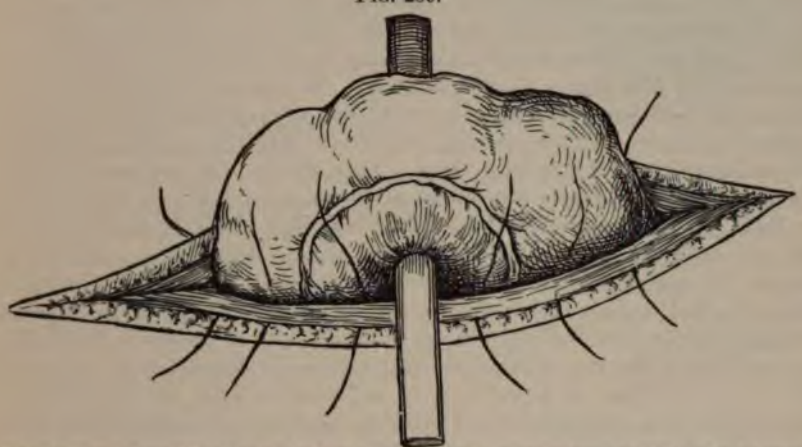
288.) This will ensure a still more prominent spur: when the artificial anus is not intended to be a permanent one, this step should be omitted. After the tying of these sutures their ends should be cut short and the rod replaced upon the surface of the abdomen. The projecting knuckle of bowel should now be sutured to the edges of the parietal wound at a number of points on each side. Small, moderately-curved needles, armed with paraffined silk, should be used. These sutures should not transfix the skin and superficial fascia, but should traverse only the deeper fascio-muscular and peritoneal layers of the wound-edges and the serous and muscular walls of the bowel. (See Fig. 289.) The sutures should be cut off an inch or more away from the knot to facilitate their later identification and removal. The exposed surface of the bowel should now be covered with strips of sterilized oiled muslin or mackintosh protective. The circumvallating wound-gutter should be packed with iodoform gauze, and over all a thick protective covering of gauze and cotton should be placed, the whole to be kept in place by a suitable abdominal binder.

By the end of three days the formation of reliable adhesions between the bowel and wound-edges will have occurred, and the opening of the

bowel may be done at any time thereafter at the convenience of the surgeon.

Should the obstructive symptoms be very urgent, the bowel may be opened at once or after a few hours only, with but little risk of

FIG. 289.



Iliac colostomy; knuckle of colon held in wound by rod; sutures inserted and ready for tying.

peritoneal contamination, provided even and close suturing of the bowel into the wound has been done.

The opening of the bowel is a simple and painless procedure. The protruding bowel-wall, having been seized by a toothed forceps and snipped through by scissors, is cut away all around to within about a half inch of the suture-line. Usually a number of blood-vessels will spurt when cut and will require to be clamped and ligated.

If the artificial anus is not intended to be permanent, the excision of the bowel-wall should be omitted and nothing more than a free longitudinal incision be made. The edges of the incised bowel may be attached to the edges of the primary skin-incision by two or more points of suture on either side. At the end of a week the supporting rod, which until now has been kept in place, should be withdrawn and all sutures removed. This will be followed by a gradual retraction of the bowel into the abdominal cavity, by the effacement of the spur, and by the renewed entrance of fæces into the lower segment. The artificial anus is thus converted into a fecal fistula which is to be dealt with as already described.

If a permanent artificial anus is desired, the bowel should be entirely divided transversely, the rod affording a convenient guide for the dividing knife. The end of the lower segment may be allowed to retract; subsequent cicatricial contraction may close it entirely: if this does not occur and trouble is caused by the leakage of fecal matter into it from the artificial anus, its edges may be freed sufficiently to allow of their being invaginated and the opening closed by sutures. Should, on the contrary, it be desirable to keep it patent to allow of irrigations of the lower segment, a good-sized rubber tube may be passed into it, around which a packing of iodoform gauze may be placed.

The edges of the upper segment should be sutured to the edges of skin-wound, so as to diminish as much as possible the cicatricial ring at the muco-cutaneous junction. By care in this respect any subsequent trouble from contraction of the opening will be prevented.

After-cares.—The emptying of the bowel after the opening has been made should be left to nature. Such hygienic and medicinal measures should be employed as will prevent diarrhœa and favor solidity of the fæces. With care the bowel may usually be trained to empty itself at a regular time each day. In the intervals the opening should be covered by a small pad smeared with zinc ointment, supported by a larger pad of cotton wool and an abdominal binder. In addition, a truss, similar to the ordinary truss for hernia, with a hard-rubber pad to press upon the opening, may be worn, but is usually not required.

The voluntary control of the new anus, even when it has been possible to avoid division of the muscular fibres which surround it, will always be imperfect, and when the bowels are at all relaxed none at all can be relied upon. Except at such times, however, the management of the fecal evacuations may be so conducted as to secure to the patient a considerable degree of comfort and activity. Excoriations about the new anus may best be prevented or relieved by frequent cleansing and by the free use of oxide of zinc as an ointment or as a powder dusted upon the skin-surface.

Prolapse of the mucous membrane through the new anus has been a frequent occurrence when the care to secure a portion of the colon with a short mesocolon has been neglected. If the disability is at all great, the prolapsed portion should be excised, and the stump of intestine again sutured into the wound, great care being taken to avoid possible peritoneal contamination.

Right Iliac Colostomy.—The colon upon the right side is to be exposed by an oblique incision as on the left, *mutatis mutandum*. The absence of any meso in this part of the bowel precludes the possibility of bringing it out as a loop through the parietal walls. A considerable fold of it, however, may be pulled out and secured by sutures in the wound. The later opening is to be done as upon the other side. The farther along the colon from the ileo-cæcal junction the opening can be made, the greater will be the future comfort of the patient on account of the diminished fluidity of the fæces. The fæces discharged through a right iliac opening are usually fluid and often irritating to the skin: their escape is at short intervals, and the resulting disability from the local irritation and the constant presence of fecal matter upon the dressings is considerable. A right iliac colostomy is therefore to be regarded only as a temporary expedient in threatening collapse from an obstruction in the ascending or transverse colon. As soon as the condition of the patient who has been subjected to it will admit an ileo-colonic anastomosis should be made and the right iliac fistula closed.

Lumbar Colostomy.—The patient is placed in the latero-prone position, right or left as the case may require: a sand-bag or other firm pillow is thrust under the opposite side of the abdomen, so as to make prominent the loin to be operated upon. The skin-incision should begin behind at the outer edge of the erector spinæ, just below the border of the last rib, and run obliquely downward and forward toward the ante-

rior superior spine of the ilium for four or five inches. This incision should be deepened by successive cuts until the edge of the quadratus lumborum muscle and the transversalis fascia have been identified and freely divided. The bowel, if distended—and it is chiefly in such conditions that it is to be reached through a lumbar incision—bulges into the opening created by the strong retraction of the wound-edges. It must be exposed sufficiently to be identified by its anatomical structure as the colon, and then pulled up into the wound to the level of the skin. The angles of the parietal wound are now sutured, and the wound thus diminished until it simply embraces the protruding knuckle of gut all around; the skin-edges and the bowel are now united by many points of sutures which pass only to the submucous coat. The further care and attention required do not differ materially from those required in iliac operations. If the case be not urgent, the bowel may be further supported in the wound until it is to be opened by two hare-lip pins passed through the bowel transversely to the wound, on the edges of which they rest. Immediate opening of the bowel, however, will much more frequently be imperative, since it is especially in cases of prolonged obstruction and extreme bowel-distention that the opening in the loin is made.

Conditions other than carcinoma of the rectum may require relief by colostomy. These include congenital malformations which cannot be relieved by perineal or sacral incisions; recto-vesical fistulæ; intractable ulcerations of the rectum; and some cases of non-malignant stricture of the rectum. The indications for colostomy in each of these conditions will be stated in their appropriate place.

SARCOMA is very rare as a primary tumor of the large intestine or of any part of the alimentary canal. More frequently the bowel is secondarily involved in growths arising in other viscera or in adjacent connective tissue.

Of the cases of primary intestinal sarcoma that have been reported, by far the greater number have been seated in the lower third of the rectum (Ball,[1] Esmarch,[2] Nepveu,[3] Paneth[4]). Growths arising in the sigmoid flexure and the cæcum have been reported (Abbe,[5] Anger,[6] Nepveu). The distinction between the sarcomata and the carcinomata of the intestine is merely a pathologic one. Clinically, they are practically identical. Usually, it will not be until after the extirpation of the growth or the post-mortem inspection that the differentiation will be made.

AFFECTIONS PECULIAR TO THE RECTUM AND ANUS.—*Exploration of the Rectum.*—Preliminary inquires will precede physical examination. They should be full and systematic. They should be particularly directed toward elucidating the duration and march of the symptoms; their effects upon the general health; the existence, character, and circumstances of pain; the frequency and character of the stools; the nature of any rectal

[1] Ball, *The Rectum and Anus*, p. 341.
[2] Esmarch, *Die Krankheiten des Mastdarmes und des Afters*, p. 195.
[3] Nepveu, *Mémoires de Chirurgie*, Paris, 1880.
[4] Paneth, "Ueber einen Fall von melanot. Sarcom des Rectums," *Archiv für klinischen Chirurgie*, 1882, xxviii. 179–193.
[5] Abbe, *Annals of Surgery*, 1895, xxi. 592.
[6] Anger, *Bull. et Mém. Soc. Chirurgie de Paris*, 1893, xix. 636.

discharges other than fecal; any protrusion from the anus; any loss of power of the sphincters; and, finally, any evidence, past or present, of tuberculosis or syphilis.

Physical Examination.—When possible the bowels should have been emptied by a cathartic administered the previous day, and the rectum should have been washed out by an enema immediately before an examination is made. For examinations of the higher portions of the rectum these precautions are indispensable.

Position.—The latero-prone, exaggerated lithotomy, and the knee-chest positions have each their particular indications and advantages. For ordinary digital and bougie examinations the latero-prone position (Sims position of the gynecologist) is most convenient; for the more careful scrutiny of the anus and for speculum examination of the lower third of the rectum the exaggerated lithotomy position (see Fig. 290) is the

FIG. 290.

Exaggerated lithotomy position for anal and rectal examination.

most satisfactory; the higher portions of the rectum can only be brought into view while the patient is in the knee-chest position (Fig. 291).

An ordinary table makes the most convenient support for the patient during these examinations. In many instances the necessary manipulation for securing thorough examination of the parts can be carried out only under general anæsthesia and after relaxation of the sphincter by over-stretching. For the illumination of the higher portions of the rectum through cylindrical specula reflected light is necessary.

External Inspection.—After careful inspection of the condition of the anus and perianal region, if the anus is gently pulled open with the fingers and the patient made to strain down, considerable eversion of the mucous membrane can be produced, which will be the greater according as the sphincters are more relaxed. It will be increased still more

if the patient assumes the ordinary position for defecation. Much information as to hemorrhoids, polypus, prolapsus, and fissure of the anus is obtainable by these means.

Digital Examination.—The well-lubricated index finger is gently insinuated through the anal orifice and systematically palpates the inte-

FIG. 291.

Knee-chest position for examination of higher rectum (Kelly).

rior of the rectum as far as it will reach. If the patient strain down while standing or squatting, from one to two inches more of the rectum will be brought within touch of the finger than could otherwise be reached. But little information in regard to hemorrhoids, ulcers, or fistulous openings can usually be gained by the touch. The state of the sphincters, the presence of fecal matter, the existence of indurations and constrictions of the rectal walls, the presence of tumors, benign or malignant, the condition of adjacent organs and tissues,—these are ascertainable by the examining finger along the lower five inches of the bowel. For further extension of the examination by the sense of touch bougies and sounds are needed.

Only soft and flexible instruments should be employed: they should be used with great gentleness and caution. They should be hollow, so as to permit the injection of water through them into the portion of the bowel beyond the advancing end, so as to efface any folds of mucous membrane that might otherwise obstruct their advance. The field of usefulness of such explorations is very limited: in a healthy bowel the sensations conveyed by them may be quite misleading; in a diseased bowel their use is dangerous on account of the ease with which a perforation of the softened bowel-wall may be made.

The introduction of the whole hand through the anus into the rectum,

and its gradual insinuation for some distance along it to palpate the upper rectum, is possible, but rarely justifiable. Experience has shown that the danger of rupture of the rectal wall is a positive one, while the amount of information to be gained by it is much lessened by the closeness with which the muscular wall of the bowel grasps the fingers, and by the perplexing way in which the folds of mucous membrane fall over them. Exploration from the peritoneal side by a finger introduced through an incision in the anterior abdominal wall is to be preferred for ascertaining the condition of the upper rectum or the sigmoid flexure.

Internal Inspection.—The interior of the rectum throughout its whole length can be inspected through a cylindrical speculum not more than an inch in diameter while the patient kneels in the knee-chest position. The speculum should be furnished with an obturator, by means of which its introduction through the anus and its insinuation along the interior of the bowel are attended with but little pain. An instrument such as the short proctoscope of Kelly,[1] five and a half inches long and four-fifths inch in diameter, is long enough to bring into view the rectal mucosa up to a point six inches from the anal verge. With care a cylinder of twice its length can be passed up the bowel, through which the lower portion of the sigmoid flexure can be inspected. As soon as the obturator is withdrawn after the speculum has been introduced the air rushes in and distends the interior of the bowel. This distention can be relied on as far up as the junction of the sigmoid. By varying the direction of the open end of the speculum and slowly withdrawing it every part of the mucous lining can be plainly brought into view if the illumination of the field by a strong reflected light is provided for. (See Fig. 291.) Should masses of fæces interfere, they may be removed by a suitable scoop; patches of mucus may be wiped away by a bit of cotton on a long probe. It is essential that the chest be held close down to the surface of the table, that no constriction of the abdomen exists, and that the abdominal muscles be fully relaxed. The full elaboration of this method of inspecting the higher rectum is due to Kelly[2] of Baltimore. General anæsthesia greatly facilitates the practice of the method.

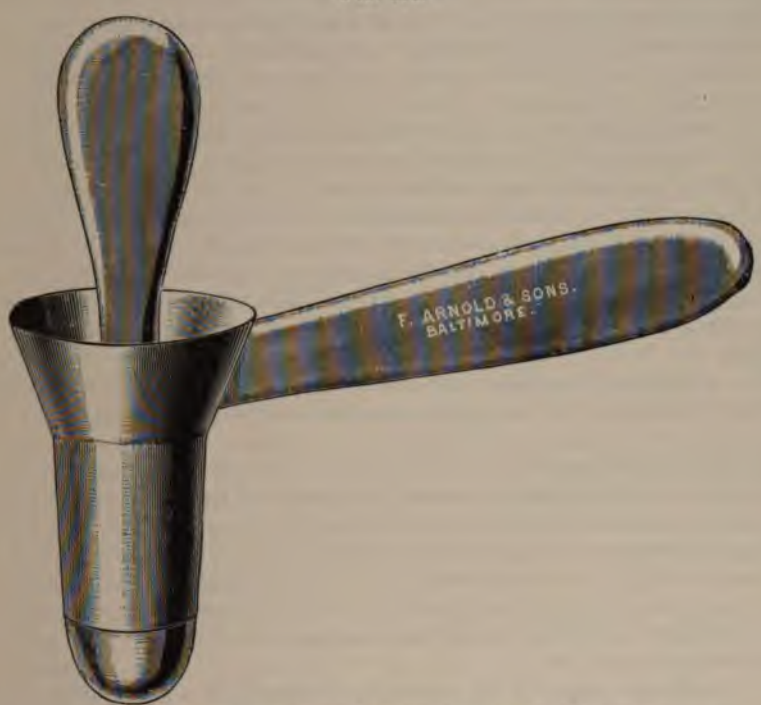
The great majority of rectal affections are seated at or just within the anal verge. For the inspection of this portion of the rectum, the sphincteric area, and the mucous membrane just above, a shorter cylinder and one of greater diameter is desirable. By the use of the instrument depicted in Fig. 292, the sphincteroscope of Kelly, the lower two inches of the rectum can be inspected very fully and with the least possible pain to the patient. After it has been introduced and the obturator removed, by withdrawing it slowly by steps, each time pushing it back a little, the whole sphincter-area is brought perfectly into view. Each time it is pushed back the movement should not be with such force as to cause it to re-enter the portion of the bowel just left, but simply sufficient to flatten out the area in view for a more perfect exposure. By the aid of any simple retractor, after having paralyzed the sphincter by over-distention, the pelvis being elevated and the abdominal wall relaxed by an anæsthetic if necessary, the internal surface of the rectum may also be quite well inspected. While the border of the anal opening is strongly retracted the bowel is distended by air, as described in connec-

[1] *Annals of Surgery*, 1895, xx. 468. [2] *Loc. cit.*

tion with cylindrical specula, and by the proper management of the light may be fully illuminated and viewed throughout much of its course.

Dilatation of the anus by a bivalve speculum is practicable without previous distention of the sphincters and without an anæsthetic. The

FIG. 292.



Short speculum for inspecting the lower two inches of the rectum.

procedure is likely to be a painful one, and, barring exceptional cases, to be unsatisfactory in its results.

General anæsthesia is always useful and often indispensable in securing thorough exploration of the rectum. It is required also in most operative procedures for the relief of rectal disease. In cases that require an anæsthetic it is well to be prepared to proceed at once to the performance of whatever operative procedures the conditions revealed by the examination may indicate.

Forcible dilatation of the anus, causing temporary paralysis of the sphincters by over-distention, is of the greatest value in facilitating thorough inspection of the interior of the rectum, as well as in the after-treatment of many conditions. It may be done by introducing the two thumbs, back to back, deeply into the anus, and forcibly separating them until they touch the ischial tuberosities on either side. More or less laceration of the mucous membrane is usually caused by this procedure if it is done rapidly. It is better that the distention be done gradually, exerting the dilating force in every direction around the anal

circumference. A conical metallic plug with a diameter at its largest end of not less than two inches may be used instead of the thumbs. After being well lubricated it is bored into the anus, producing rapid and uniform over-distention of the sphincters. The atony of the sphincters which results from this stretching usually lasts for about a week. It is rarely followed by even temporary incontinence of fæces.

TRAUMATISMS OF THE ANUS.—Wounds of the outlet of the rectum have special significance from the damage to the sphincters which they may have inflicted and from the consequences of fecal extravasation into the adjacent connective tissue. Injuries of the higher rectum have already been considered. Wounds of the outlet of the rectum may be of every degree, from linear lacerations of the mucous membrane by the expulsion of hard fecal masses or slight punctures by sharp-pointed or angled foreign bodies which may have passed through the alimentary tract, to extensive lacerations reaching widely into the ischio-rectal space or perineum in cases of perineal impalement or in the much more common lacerations of the perineum and recto-vaginal septum during parturition. The rectum is sometimes wounded in the course of a perineal lithotomy and during operations upon the perineum and vagina.

In all wounds dividing the whole thickness of the rectal wall the primary indication is the prevention of septic extravasations. If the sphincter is not already divided by the wound, it should at once be temporarily paralyzed by over-distention: in many cases, as in perforation of the rectum just above the sphincters, it would be best to freely divide the sphincter and rectal wall up to the point of injury, and thus forestall at once the possibility of diffused septic infiltration. The general principles which govern the use of drainage in any part of the body apply to wounds of the rectum: in this region septic contamination is practically unavoidable; the unrestrained discharge of its products must be provided for.

Hemorrhage requires for its control simply the application of the general rules of hæmostasis. The cardinal rule that the bleeding point shall be first exposed is imperative in the surgery of the rectum. Whatever dilatation or incisions of the rectum may be required to effect this should be done without hesitation and the point of bleeding brought into view. Blind tamponing of the rectum for the control of bleeding is to be absolutely condemned. The ligature, the clamp forceps, and the actual cautery afford sufficient and secure means of checking bleeding in all cases.

The permanence of the loss of power in the sphincter after its division, whether by accidental traumatism or by operative wound, will depend on the degree of permanent separation of the stumps of the muscle and the amount of injury which may have been inflicted upon the inferior hemorrhoidal nerves. Multiple transverse wounds of the muscle may not entail fecal incontinence, provided there has been little separation of the divided ends, while division of a single point may be followed by complete loss of power if the ends have been suffered to remain retracted much during the healing. The disability following complete perineal ruptures during childbirth is an illustration of the latter statement. Too extensive circumanal incisions in the treatment of

tortuous fistulous tracts may divide the hemorrhoidal nerves to such an extent as to permanently paralyze the sphincters, aside from any wound of the muscle itself. Although experience has shown that, as a rule, a single complete division of the sphincter when allowed to heal by granulation does not entail fecal incontinence, in the treatment of wounds of the anus the divided ends of the sphincter should, if possible, be brought together by sutures, preferably silkworm gut or silver wire, to secure their union in close apposition, while the recesses of the wound that may extend outward among the tissues of the ischio-rectal fossa should be independently treated by packing or deep suture as the necessities for drainage may require.

The amount of annoyance caused by loss of power of the sphincters will depend upon the state of the bowels and the relaxation of the tissues at the anal outlet. There is always entire lack of control over the escape of gases: the fæces, as long as they are well formed and semi-solid, may habitually present for escape at a certain time only each day, and may be held in partial check by hypertrophy of the lower circular fibres of the rectum and by cicatricial contractions at the outlet. Diarrhœal discharges find nothing to arrest their frequent involuntary escape. Some intestinal mucus flows out from time to time, so that the constant wearing of an absorbent pad over the anal orifice is necessary. When there is much relaxation of the anus prolapse of the rectum is prone to occur.

Partial incontinence, the loss of sphincteric control being incomplete, may be much relieved by superficial linear cauterizations with the actual cautery. These lines should radiate from the anal margin, and should be deep and long enough, so that, when healed, some contraction of the outlet should result. An increase in the tonicity of the sphincter itself will also be produced.

Proctoplasty.—Plastic operations for the restoration of the continuity of the sphincters are practicable in cases of healing with retraction, without extensive destruction of muscle or division of nerves. The ends of the sphincter should be exposed by suitable incisions, the cicatricial tissue excised, and suture of the sphincteric stumps made as already described in the case of recent wounds. The sphincter muscle should be temporarily paralyzed by over-distention previous to applying the suture. A liquid stool should be secured by laxatives on the second day after the operation, and this condition of the stools should be maintained for a period of two weeks thereafter.

In the cases in which suture is impracticable or unsuccessful the lower part of the rectum may be dissected from its attachments and twisted upon itself, after the method of Gersuny (see page 493), and secured permanently in a state of torsion by suitable sutures.

Among the traumatisms should be classed the persistent painful *fissures of the anus*, which owe their origin frequently to a slight laceration of the muco-cutaneous covering at the anal verge during the expulsion of a large, hard fecal mass, and are perpetuated by the often-repeated stretching and irritation of subsequent defecations. Not every break or excoriation of the anal verge degenerates into such a fissure. In many cases recovery occurs without any serious trouble having occurred. Some pre-existing dryness or slight inflammatory induration

of the part, such as might be caused by the use of harsh or irritating substances to cleanse the anus, or by the indurations that attend irritated piles or small marginal follicular inflammations or protruding polypi, predispose to this affection, while also the frequent repetition of the exciting traumatism, as in persistent constipation, or an irritating character of the fecal discharges, is essential for the production of the condition. An irritable state of the sphincter is provoked by the repeated insults to the highly sensitive terminals of the hemorrhoidal nerves which are exposed at the bottom of the fissure. The resulting sphincteric spasms increase the irritation and pain and help further to perpetuate the condition. The pain which is produced by a stool is such as to cause the patient to defer defecation as long as possible. As a result, the masses ultimately voided will be hard, and at each stool will tear open anew the fissure into which they are forced by the spasmodically contracted sphincter. The resisting sphincter may permit the fæces to pass only in a slender cylinder or in flattened, tape-like masses.

The **symptom** characteristic of fissure is paroxysmal pain, always associated with the act of defecation. While the fæces are being voided there is more or less acute pain, which increases in severity after the act and lasts for a considerable time, in some cases even for several hours. It is of a dull, intolerable character that for the time completely prostrates the patient. After it ceases it does not recur until the bowels again move. The fæces may be streaked with blood and smeared with muco-pus. Reflex pains in the loins and lower limbs are common. The amount of pain in some cases is so severe and prolonged as to cause decided constitutional depression. The opium habit may easily follow the frequent use of morphine for the relief of the pain.

The **diagnosis** is readily established by a careful inspection of the anus, which should invariably be resorted to whenever the patient complains of the symptoms of pain above described. At first view a small congested excrescence or external pile may alone be detected; often not even this is visible. If the finger is pressed into the anus, great pain and violent sphincteric contraction are caused. If, while the patient makes a bearing-down effort, the walls of the anus be drawn to either side, a raw fissure will be exposed which extends upward within the grasp of the sphincter. By dilating the anal orifice still more, or with the aid of a bivalve speculum, the whole length of the fissure may be brought into view as a shallow ovoid ulcer perhaps half an inch or more in its longest diameter. The usual site of such a fissure is upon the posterior border of the anus, but it may develop at any part of its circumference. Often the spasmodic action of the sphincter is so great or the pain excited by the efforts at examination so intolerable that no adequate examination can be made until a general anæsthetic has been given.

As to **treatment**, cases may be divided into three categories: (1) Those of recent origin, uncomplicated by piles or polypi, in which the laceration is not deep and the reflex spasmodic symptoms are not excessive. These may be conducted to a speedy healing by the use of laxatives to ensure loose stools and the local application after each stool of a mildly stimulating ointment, as of belladonna and Peruvian balsam. (2) Uncomplicated cases of a more severe type, yet in which adequate examination is possible without the use of a general anæsthetic: in these cases,

after local anæsthesia has been secured by packing the fissure for five minutes with a pledget of absorbent cotton saturated with an 8 per cent. solution of cocaine, the anus should be dilated with a bivalve speculum sufficiently to well expose the whole extent of the ulcer, and then with a sharp knife a longitudinal incision should be made through its base and through the superficial layer of the sphincter underneath, perhaps dividing one-third of its thickness. The cut should also extend into the healthy mucous membrane above and into the sound skin below. Immediate relief to pain and subsequent rapid healing follow under the use of laxatives and mildly stimulating ointments. (3) Cases of long standing attended with much sphincteric spasm and local sensitiveness, and those complicated by polypi or piles. In these cases no extended examination should be made until after a general anæsthetic has been given. Then the sphincter should be over-distended by forcible dilatation, the surface of the ulcer should be curetted, its edges if undermined trimmed off, and any complicating conditions, such as polypi or piles, be appropriately treated. The exposed parts should be well dusted with iodoform, and the subsequent use of laxatives and ointments be adopted as in other cases.

ACUTE INFLAMMATIONS. — *Proctitis.* — Dysenteric and diphtheritic inflammations of the rectum, and those conditions in which the rectum shares in the disturbances of a general colitis, belong to the domain of internal medicine. Local inflammations of the rectum, demanding the attention of the surgeon, may be induced by the presence of other rectal disease, as hemorrhoids, polypi, and prolapse, or by the irritation of foreign bodies, such as hard retained fecal masses, sharp substances brought down by the fæces and arrested by the sphincter, irritating suppositories, or the frequent careless introduction of an enema-tube. The presence of intestinal worms, the abuse of purgatives and enemata, local chilling as by prolonged sitting upon a cold, wet seat, are each occasional causes. It may result from gonorrhœal infection conveyed during unnatural sexual contact or by the accidental entrance into the rectum of infective discharges. Inflammation of neighboring organs may extend to and involve the rectum.

The **symptoms** are pelvic discomfort and anal tenesmus, with frequent passage of scanty stools, at first of fæces mixed with bloody mucus, later of bloody mucus or of muco-pus alone. Some œdema and prolapse of the rectal mucous membrane alone are frequent. Bladder-tenesmus is a frequent complication.

The **course** of the disease is toward spontaneous cure, provided the cause is removed. The persistence or frequent repetition of the cause may produce a chronic inflammatory condition or provoke necrosis and ulceration of the mucous membrane or extension of the infection into the perirectal connective tissue. Abscesses, fistulæ, and stricture may occur as sequelæ.

The **treatment** should first be directed toward the cause. Local examination causes great pain, but should not be omitted: if necessary, an anæsthetic should be administered. If this is given and the sphincter thoroughly dilated, it will not only facilitate the local examination and the necessary procedures for the removal of the cause in many cases, but in all will greatly relieve the tormenting tenesmus during the sub-

sequent course of the case. The recumbent posture is important. A saline purge should be administered to evacuate the bowels, and subsequent laxatives should be used to keep the stools liquid. Small amounts of starch-water and laudanum (℥ij to gtt. xx) may be injected into the rectum every two or three hours. Hot fomentations over the hypogastrium and to the fundament, and hot sitz-baths, will be comforting during the more acute stage.

Periproctitis.—The connective tissue about the rectum and anal outlet may be the seat of inflammations of every degree of intensity. The local conditions are so especially favorable for septic infection that inflammations of such origin are of greater frequency in this region than in any other portion of the body. The frequent bruising and slight lacerations to which the anal outlet is subjected in efforts to void hard fecal masses, or which are caused by the use of harsh or rough substances for wiping the anus after defecation; repeated slight contusions as in horseback-riding, or the more positive contusions from kicks or falls on the fundament; slight traumatic perforations such as those due to the unskilful use of an enema-tube or from some sharp angular foreign substance in the fæces; excoriations caused by the pressure of hard fecal masses retained in the valve-like folds just within the anus or by lack of cleanliness externally,—these are among the most common conditions which may serve to open the absorbents of the region to the entrance of septic material. The epithelial abrasions or distinct losses of substance which frequently attend hemorrhoids, proctitis, neoplasms of all kinds, fissures, and ulcers always entail danger of deeper infection. Operations upon the anus or rectum in which the retention of discharges has not been fully guarded against may give rise to septic cellulitis. Perirectal abscesses may be due to infection received from some other organ than the rectum, as in disease of the pelvic bones, abscesses arising from the appendix vermiformis, from the bladder, from the prostate, from the glands of Cowper, from urinary infiltrations of the perineum, and not infrequently from the broad ligament.

The bacterium commune coli is the micro-organism found most frequently and in largest numbers in the abscesses of this region. The various species of pyogenic cocci, both streptococci and staphylococci, are also often present. Perianal tubercular infection is very common. Secondary infection of the original tuberculous focus by the ordinary pyogenic organisms may impress the character of an acute phlegmon upon the tuberculous process.

The infection may be transmitted along the lymphatics and venous radicles of the region to some distance from the point of primary entrance, determining phlegmons in the deeper recesses of the ischio-rectal fossa or even as far away as the gluteal region; more commonly the area of inflammatory reaction is superficial and is located immediately under the skin and mucous membrane.

Diffuse Phlegmon.—In occasional instances, as a result of infection occurring in an individual, the resistance of whose tissues has been lessened by some cachexia, as that of diabetes, of chronic alcoholism, or of an infection that has been extensive and extreme, as in the large opening up of connective-tissue spaces in operations upon the rectum without adequate drainage, the septic process continues to diffuse itself

unchecked along the connective-tissue planes about the rectum and of the pelvis. The inflammatory infiltration may thus extend upward and inward behind the rectum into the iliac fossa and forward into the perineum, and even into the hypogastrium. The tissues become widely infiltrated with pus and extensive necroses occur. In the more extreme cases pyæmic infection with multiple metastatic abscesses in distant regions, especially the liver, is early produced, while infection of the peritoneum is common if the patient survives for any length of time.

Circumscribed phlegmons vary in their clinical manifestations and importance according to their relations to the muscular apparatus of the anal outlet. The infection may not extend beyond the connective tissue immediately beneath the skin or mucous membrane: the abscess that results is a superficial one; it may be limited to the region outside the sphincter, in which case it is a subcutaneous marginal abscess; it may undermine the muco-cutaneous junction and extend upward beneath the mucous membrane of the rectum beyond the sphincter—a submucocutaneous abscess; or it may begin and remain an affection of the submucous tissue above the sphincter, being a pure intramural abscess. Such superficial limited infections constitute the most frequent forms of periproctitis. A large proportion of them are of tubercular origin. Most fistulæ in ano have their origin in them.

Phlegmons which involve the tissues of the ischio-rectal space beyond the sphincters, *ischio-rectal abscesses* proper, occasion more marked constitutional reaction, and may assume grave proportions by progressive infections, presenting in different cases every grade of severity between a superficial furuncle and a fatal diffuse cellulitis. An infection which at first caused simply a marginal abscess may extend into the deeper tissues of the ischio-rectal space, or the primary focus of inflammation may have been in that space as a result of a lymphangitis originating in the rectum or anus. The levator ani muscle forms a barrier which is usually efficient to prevent the extension of the phlegmonous process above it: the usual direction in which the process extends is toward the cutaneous surface, upon which it ultimately spontaneously opens. Before such a termination, however, the destructive process may have extended widely throughout the whole region, possibly forward into the perineum or outward to the buttocks, undermining the skin and mucous membrane, dissecting out the sphincter, and degenerating later into tortuous and branching sinuses connecting with the point of external discharge. In some cases the musculo-fibrous barrier above is broken through, and the tissues above the levator become involved in the phlegmonous process. In yet other cases the phlegmon begins in the tissue above the levator, and, perforating it, becomes later superficial in the ischio-rectal space. Perforation of the rectal mucous membrane is common at some period of the abscess-history.

The general septic phenomena that attend the more deeply-seated ischio-rectal phlegmons are severe, including rigors, high temperature, and marked general prostration. Pyæmia may result. Every grade of tissue-necrosis may be produced. Erosion of the larger hemorrhoidal veins may occur, resulting in severe, even fatal, hemorrhage. Intractable and extensive fistulæ are common sequelæ. Deforming and disabling cicatrices may also remain after the healing.

The **symptoms** that mark the development of the superficial subcutaneous or submucous marginal abscesses vary according to the character of the infection. Abscesses of tubercular origin may attain considerable size, even to the extent of spontaneous rupture, without other symptoms than slight local uneasiness. More frequently the usual symptoms of a local phlegmon are present. An increasingly painful and tender tumefaction of the anus develops, defecation is painful, there is a general febrile reaction. These symptoms continue to increase in intensity for some days until evacuation of the abscess occurs. Should the abscess be limited to the submucous tissues, but little external tumefaction may be visible, and only by passing the finger into the rectum will the swelling be discovered by careful palpation.

Ischio-rectal phlegmons, when superficial, at once declare themselves by the unmistakable signs of local inflammation, increasing in intensity until the accumulating pus escapes either into the rectum or upon the external surface. When the focus of inflammation is more deeply seated, local pain and general fever will direct attention to the region and to the character of the process going on for some time before any superficial redness and swelling are visible. In such cases deep pressure will develop at one side of the anus a region of special tenderness and obscure induration, which will be more plainly made out if at the same time a finger is introduced into the rectum and the exploration be made by combined external and internal palpation. As the phlegmonous process extends and becomes more superficial a protruding fluctuating swelling presents in the ischio-rectal space, usually confined to one side, not infrequently extending outward to the buttock, sometimes forming a vast tumor extending from the root of the scrotum to the coccyx and from one tuber ischii to the other.

The abscesses which arise from neighboring organs and later burrow into the ischio-rectal space will be preceded by the special symptoms of inflammation of the organ primarily affected. They generally invade the perirectal spaces above the insertion of the levator ani, and frequently discharge themselves into the rectum.

Treatment.—The diffuse form of periproctitis demands immediate and most energetic measures to antagonize the advancing septic process and limit its extension. Any possible retention of the secretions, of gangrenous débris, or of fecal material must be provided against by such extensive incisions into the infected region as may be needed to open up every recess so freely that there may be ready and uninterrupted escape of the septic matters. Necrotic material should be cut away whenever discovered. Such frequent and copious irrigation of the wound-cavities should be made as may be required to wash away the more solid matters that might accumulate or to assist in the discharge of the fluid secretions. The flagging powers of the patient must be stimulated by appropriate diet and by such agents as alcohol, strychnia, and quinine. If these methods are early and fully carried out, further extension of the septic process may be prevented and ultimate healing by granulation possibly secured, except in the presence of some extensive general cachexia, as that of diabetes, chronic alcoholism, or uræmia, which has destroyed the possibility of tissue-resistance to septic attack. Should septic peritonitis or distant metastatic abscesses have already

developed, all treatment will be ineffectual and the case will steadily advance to a fatal termination.

Diffuse periproctitis, formerly a not infrequent sequel to operations upon the rectum, is now rarely met with since thorough antiseptic operative precautions have become matters of routine employment and the importance of after-drainage has become understood. The prevention of this form of inflammation will always command the serious attention of the surgeon in any operation upon the rectum.

Circumscribed phlegmons about the anus or rectum, wherever located and of whatever extent, should be freely incised as soon as detected. Temporizing with poultices or leeches or ice-bags in the hope of averting suppuration will certainly be attended with disappointment, while the postponement of the incision until the abscess has become superficial and forms a projecting fluctuating tumor exposes the patient in the mean time to the possibilities of diffuse infection and of pyæmic accident—while it ensures a more extensive local tissue-destruction, undermining more or less widely the perirectal tissues, and leading to the subsequent formation of persistent fistulæ.

The incision should be free enough to expose the whole extent of the abscess, the cavity should be explored for diverticula, and these should either be broken down so as to form one cavity with the central one, or should be opened up by additional incisions extending from the primary cut. Incisions should be made radiating from the anus, rather than circumscribing it. This is especially important when they have to be carried to any depth, lest hemorrhoidal nerves should be divided. Superficial incisions can be carried in any direction that may be required to open up diverging sinuses.

In marginal abscesses that undermine skin and mucous membrane the anus should be dilated and the pus-cavity should be incised throughout its whole extent, irrigated, and packed with iodoform gauze. No division of the sphincter is required: the mucous membrane may be divided freely without hesitation; rapid healing by granulation without fistula or loss of sphincteric power may be depended on. When the phlegmonous process has also involved the deeper tissues of the ischio-rectal space, the primary incision should be extended outward from the anal margin to the external limit of the pus-cavity; such secondary incisions may be added as may be required to open up any branching recesses. The muscular apparatus of the anus may be preserved intact, as a rule, unless the abscess has already perforated into the rectum before the external opening, by the knife or spontaneously, has been made. In such cases its degeneration into a fistula is certain, and the free division of the sphincter by an incision dividing all the tissues lying between the internal and external openings will be necessary to secure healing.

Abscesses of the superior pelvirectal space should be evacuated by external incision as soon as their presence is made out, lest they should burst into the rectum—an accident that is to be prevented if possible. If the pus-cavity is behind or at the side of the rectum, it may be reached by a median posterior incision or a parasacral incision; if in front, a transverse perineal incision will be required in the male, a vaginal incision in the female.

Fistula in Ano.—Abscess-cavities situated in the vicinity of the

anus after they have been opened are prone to degenerate into persistent fistulous tracts. In the causation of this imperfect repair several conditions combine: the venous current is habitually sluggish on account of the peculiarities of the veins of the region and by their dependent position when the person sits or stands; the parts are subjected to frequent disturbance during defecation and walking; the frequent entrance of irritating and infectious material from the mucous or cutaneous surfaces is unavoidable; the orifices of discharge are often small, while the suppurating canal may be tortuous or branching or the seat of irregular dilatations, so that more or less retention of irritating secretions is produced. According as the surgeon appreciates the later effect of these conditions, and is able to provide against them in the treatment of the original abscess will the probability of the formation of a fistula be lessened or increased. In the case of abscesses of tubercular origin, which are of frequent occurrence, the persistence of tubercular degeneration in the abscess-wall is sufficient cause for the failure in repair. The walls of these fistulæ become lined with indurated granulation-tissue, the surface presenting a pseudo-membranous appearance.

In rare instances spontaneous contraction and obliteration of the fistula take place, but, as a rule, it shows little tendency to healing, while renewed inflammatory crises from the irritation of retained discharges and fresh septic invasions of the adjacent connective tissue are not infrequent. Such secondary abscesses may result in adding new diverticula and openings about the anus. In the most aggravated cases the perineum and gluteal region become extensively undermined by multiple branching and tortuous channels.

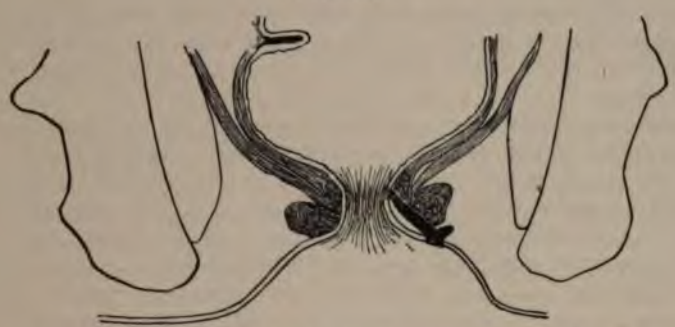
Fistulous openings in the vicinity of the anus which are caused by the burrowing of pus originating elsewhere than in the perirectal tissue are not to be classed with fistulæ in ano. Not every anal fistula, however, communicates with the gut, although in the great majority of instances there is an internal and external opening. When a fistula communicates thus both with the mucous and cutaneous surfaces, it is spoken of as a *complete fistula;* when there is but one opening, it is a *blind fistula,* external or internal according to the location of the opening.

The fistulæ which are caused by marginal abscesses run superficial to the sphincters, lying merely under the skin and mucous membrane. These are by far the most common variety. Their internal orifice will generally be found slightly above the line of the muco-cutaneous junction, just within the grasp of the sphincter. In Fig. 293 the topography of this variety of fistula is well shown. The distance of the external opening from the anal margin varies greatly. In some cases it will lie within the radiating folds of the anus itself, requiring careful inspection to detect it; in other cases it may be several inches away. The opening is usually quite small, possibly marked by a little pouting granulation or by a small depression consequent upon cicatricial contraction. Often it is temporarily closed by the agglutination of its lips, soon to be opened by the pressure of accumulated secretions. In tubercular fistulæ, however, the external opening not infrequently presents a ragged cavity of some extent.

The fistulæ resulting from abscesses of the ischio-rectal fossa channel more or less deeply that space, running outside of and above the sphinc-

ters. In the original abscess the pus, meeting a barrier to its higher extension in the levator ani muscle, followed its under surface to the rectal wall, and, finding a point of least resistance between the sphincter and the

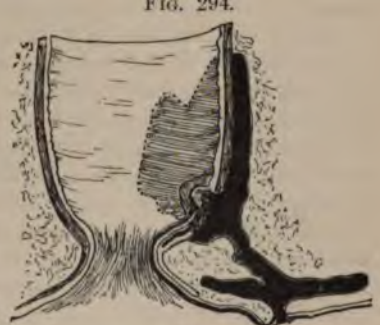
FIG. 293.



The most common form of fistula in ano: degenerated marginal abscess.

line where the levator loses itself in the rectal wall, there broke into the rectum. As a result, the internal opening of the resulting fistula is usually at the level of the upper border of the external sphincter. According to the intensity and extent of the original phlegmon, and the timeliness and freedom of the incisions for its relief, the resulting fistulous tract may more or less extensively undermine the mucous membrane of the rectum, extending upward from the internal orifice or the skin in every direction. Thus it may happen that the internal and external openings may be on opposite sides of the bowel, being connected by a fistulous tract which partially circumscribes the anus. Again, there may be multiple external openings connected by tortuous channels, or there may be branching diverticula emptying into one main channel. Fig. 294, partially diagrammatic, from Andrews,[1] illustrates well the characteristics of this form of fistula.

FIG. 294.



Fistula in ano complicated by diverticula undermining skin and mucous membrane (degenerated ischio-rectal abscess).

The so-called blind internal fistulæ differ from the externally opening fistulæ in that they do not present such distinct canal-like channels, but are more or less broad underminings of the mucous membrane which often communicate with the cavity of the rectum through ulcerated openings of some size. More rarely the internal orifice is small, and may be so hidden by the folds of the mucous membrane as to be difficult of detection.

Symptoms.—There is rarely much pain caused by a fistula, except when an acute inflammatory crisis is excited in connection with it or the blocking up of its orifices causes retention of the secretions within its cavity. The slight sero-purulent

[1] *Rectal and Anal Surgery*, p. 61.

discharge which oozes from its external orifice is a source of annoyance by reason of the irritation of the skin that it produces and the difficulty of keeping the parts clean. Complete fistulæ permit the involuntary escape of gas and fecal material. Blind internal fistulæ cause sensations of uneasiness about the fundament, sometimes aggravated into tenesmus. The stools are often smeared with blood and pus. Should retention of secretion within the fistulous tract occur, the local distress will be aggravated, finding relief again when free discharge into the cavity of the rectum occurs.

Diagnosis.—When upon careful inspection of the anal region the fistulous orifice is not at once detected, if the tip of the finger is introduced into the anus and pressed outward the induration of the fistulous tract will be appreciated by it, and possibly a drop of secretion may be caused to exude through its external orifice. When this orifice has once been detected, the direction and extent of the fistulous tract should be explored by a probe. The finger-tip passed into the rectum will recognize where the probe passes through the rectal wall, or the thickness and extent of the rectal wall between the probe and the finger. The tortuousness of the channel may be such as to render difficult or even impossible the insinuation of the probe along it from one end to the other. The injection into the fistula of a colored liquid, as milk, may help to demonstrate the location of the internal opening, while the cavity of the rectum is exposed by a speculum. The short cylindrical speculum shown in Fig. 292 is especially serviceable for such a purpose. Filling the fistulous cavities with solution of peroxide of hydrogen is even more efficient to demonstrate the location of the internal orifice by reason of the gaseous froth that it forms, which distends every recess and bubbles out through any opening that may be present. The settlement of the existence or non-existence of an internal opening previous to operation for the cure of a fistula is of but little importance. When the patient is anæsthetized, as the surgeon lays open carefully every recess and sinuosity of the fistula he will be conducted with certainty to the internal opening if such exists.

Blind internal fistulæ will be discovered only upon careful inspection of the interior of the rectum. Persistent symptoms of rectal discomfort and suppuration, not otherwise explainable, will suggest the possibility of their existence and lead to this examination.

Prognosis.—Rarely does a fistula in ano become obliterated spontaneously. As long as it exists renewed inflammatory crises are prone to appear, for which reason early surgical interference adequate to its cure is indicated. Much discussion has centred in the past about the point of the advisability of operating upon an anal fistula in a patient suffering from pulmonary tuberculosis. In the light of the pathology and clinical experience of the present day there can no longer be any hesitation or doubt on the question. Pulmonary tuberculosis forms no contraindication to the operative cure of fistula except in its advanced stages, when no benefit could be expected to accrue to a dying patient from any operation. Sluggishness in the healing is often manifested by the operative wounds made for the cure of fistulæ, and is due to the same causes which have already been enumerated as contributing to the production of the fistula in the first place. In patients whose reparative

powers are exhausted by other disease repair may fail entirely, and the fistula and the wound made for its cure together degenerate into an ulcerating excavation. Fecal incontinence as a result of an operation may be feared only in the case of multiple or deep-reaching fistulæ. In cases in which the sphincter is wholly divided, properly applied sutures and adequate provision for the drainage of the cavity external to the sphincter will secure, as a rule, healing without loss of sphincteric power.

Treatment.—In exceptional instances blind external fistulæ may be cured by dilating or enlarging their external orifice, followed by curettage of the fistulous cavity and subsequent stimulation and antiseptic applications and packings. As a rule, however, both in blind and incomplete fistulæ there will be required free division of all the tissues which separate the fistulous tract from the intestinal cavity, so as to convert the fistula into an open wound, which may then ultimately cicatrize by granulation from the bottom, or, in some cases, after excision of the infected pseudo-membranous lining may be at once sutured and heal by primary union.

Operative Technique.—The rectum should have been emptied by a purgative administered the day before, supplemented by an enema given

FIG. 295.

Operation for cure of marginal fistula in ano.

at least six hours before the operation; the perineum should be shaved and scrubbed; general anæsthesia should be induced; the patient should be placed in the exaggerated lithotomy position (see Fig. 290); over-

distention of the sphincters should be made; inspection of the lower rectum and final irrigation of it with boro-salicylic solution complete the preliminary preparations. A grooved sound is then passed through the fistula into the rectum. In the majority of cases the internal opening will be so near the anal margin that the rectal end of the sound may be readily depressed by the tip of the finger so as to emerge through the anus, as shown in Fig. 295.

A sharp-pointed curved bistoury is then passed along the groove of the sound, and is made to cut its way out, thus fully opening the entire fistulous tract. The wound-edges are held apart by suitable retractors, and a careful examination is made for any branching diverticula; should any be discovered, they should be followed up by the knife and laid open to their termination. The pseudo-membranous lining of all the tracts should now be carefully and systematically dissected out. After thorough irrigation, if the wound is deep and extensive, its deeper parts should be brought together by appropriate sutures, with such provisions for temporary drainage as the peculiarities of the case may require. If the wound is short and superficial, as is the case of most fistulæ resulting from marginal abscesses, no suturing is required; simply a fold of iodoform gauze should be laid in it. Finally, a suppository containing half a grain or more of opium should be placed in the rectum, the fundament should be plentifully powdered with oxide of zinc, and over all should be placed a soft protecting and absorbent pad of cotton or gauze, kept in place by a T-bandage. These external dressings are to be changed as often as they become soiled. A movement of the bowels should be secured on the third day by a laxative assisted by an enema, and provision should be made for subsequent daily loose evacuations. The original iodoform-gauze tampon remains in place until it is brought away with the first stool. The process of granulation should be stimulated whenever it becomes necessary by substituting for the iodoform dressing gauze saturated with balsam of Peru and naphthalin, and by occasional touchings with stick nitrate of silver.

The treatment of a blind external fistula is practically the same as that of the complete variety. Starting at its external orifice, the tract of the fistula should be followed up with the grooved sound and the knife, wherever they lead, and converted into an open wound. If it approach close to the mucous membrane, the sound may be thrust through it and thus form a complete fistula.

In case of multiple external openings with tortuous complex sinuses methodical division of all overlying tissue, starting from each external opening, will enable the surgeon eventually to identify and follow up the one leading into the intestine. The general principles of treatment that govern these complex fistulæ do not differ from those to be observed in dealing with the simpler cases. The sphincter, however, must not be divided in more than one place, lest fecal incontinence result.

A blind internal fistula should be laid open by dividing the overlying mucous membrane throughout its entire length, after paralyzing the sphincters. Persistent deep-seated abscess-cavities that empty into the rectum and are the source of blind internal fistulæ may require to be opened up from the cutaneous surface by systematic free incisions before closure of the intestinal opening can be secured. Such cases become

practically fecal fistulæ, and the principles which govern their treatment have been fully discussed under that head. (See page 443.)

Ischio-rectal fistulæ are occasionally met with which do not open into the bowel, but can be traced through the levator ani to a persistent suppurating cavity in the superior perirectal space. Frequent crises of retention and accumulation of pus with relief by the renewal of the discharge are apt to attend this class of fistulæ. The opening through the levator ani muscle is quite narrow, and it is at this point that the frequent temporary blocks occur. They are to be treated, as are similar hour-glass contractions in other parts of the body, by the incision from without inward of all intervening tissue until the bottom of the remote cavity is fully exposed. These incisions will not involve the sphincter or the wall of the bowel, but will divide only the connective tissue of the ischio-rectal fossa and the levator diaphragm. The cavity, having thus been opened, after having been curetted and irrigated should be packed and drained until it becomes obliterated by granulation and contraction.

Recto-vaginal and *recto-vulvar* fistulæ originate in conditions peculiar to the genital tract, and are properly considered in connection with other diseases of the female genital organs.

Elastic Ligature.—An elastic cord may be passed through the track of a complete fistula and be made to gradually cut its way out if its ends are tightly tied, so as to exert a constant elastic pressure upon the tissue enclosed by it. A fistulous track uncomplicated by diverticula may thus possibly be successfully treated. The method is uncertain in its results: it may awaken new inflammatory conditions; it takes no account of possible diverticula; it is a resource of timidity, to be used only when patients cannot be persuaded to submit to more thorough methods.

Chronic Proctitis.—Persistent inflammatory conditions of the rectum may be the sequelæ of the acute conditions, traumatic or infective, which have already been considered, or they may be chronic in their primary manifestations, as in syphilitic or tubercular affections and the insidious, slowly-advancing forms of non-specific hypertrophic and stenosing proctitis. The congestions attending polypi and hemorrhoids produce in most cases a more or less extensive surrounding zone of chronic inflammation, with frequent superficial necrosis, leaving persistent ulcers. Passive pederasty is a recognized cause of chronic inflammation of the rectal mucous membrane. Gonorrhœa of the rectum, whether as a result of pederasty or by accidental inoculation, may degenerate into a chronic condition. The combination of the conditions of constant infection, frequent irritation, and sluggish venous flow tends to prolong any condition of inflammation once excited in the lower segment of the rectum. To these conditions must be referred the frequency with which the ulcerative or hyperplastic sequelæ are intractable or progressive.

The inflammatory disturbance may be limited to the mucous membrane or may extend more deeply into the submucous tissues: it may be limited to a narrow zone or patch extending but a little distance from the anus, or may be more diffused, even throughout the entire rectum. In the more extensive and aggravated cases the mucous membrane is

tumefied; its surface is granular; multiple points of ulceration of varying extent occur; glandular hypertrophies frequently form, causing papillomatous vegetations to project which may develop into pedunculated growths of some size. Every combination imaginable of these different conditions of congestion, tumefaction, ulceration, and vegetations may exist in different cases. When the infiltration of the submucous tissue becomes so extreme as to nearly or quite surround the rectum, subsequent stenosis from its contraction will result.

Perianal and perirectal lymphangitis and phlebitis are frequent complications determining abscesses and fistulæ.

Clinically, cases of chronic non-specific proctitis fall into two general classes: (1) those in which superficial necroses and vegetations are the predominant features—*ulcerative and papillomatous proctitis;* (2) those in which the submucous connective tissue is the seat of a diffused hypertrophic process, producing thickening of the rectal walls, and by its later contraction causing constriction of its calibre—*proliferative stenosing proctitis.* Many cases will partake of the characteristics of both of these classes, beginning with the superficial lesions of the first class: the deeper tissues become later involved and add the special symptoms of obstructive stenosis to the still-persisting symptoms of the superficial ulceration.

Ulcerative and Papillomatous Proctitis.—Ulceration, as one of the most common and marked attendants of chronic proctitis, deserves especial consideration. An ovoid or circular ulcer of limited extent just above the sphincteric area is frequently met with. A varicose condition of the venous radicles of the region has usually preceded and predisposes to it. Hemorrhoids are usually, but not always, present. It not unfrequently remains as a sequel to the acute inflammation of a follicle in one of the sinuses of Morgagni. It may result from direct traumatism or from any cause which may have excited a local follicular inflammation, especially in persons whose powers of repair have been reduced by some general cachexia. Ulcers often arise from tubercular or venereal infection: these will be considered by themselves in a subsequent section. Multiple follicular ulcerations may exist in the rectum as in other parts of the large intestine. Dysenteric ulceration has been referred to in connection with the paragraph treating of the surgical importance of dysenteric ulceration of the large intestine as a whole (page 449).

The **symptoms** provoked by rectal ulcers are vague and irregular. Discomfort rather than pain is felt, except when the ulceration involves the sphincteric area, when the symptoms of fissure are produced. Some tenesmus is usual, provoking frequent stools, which are scanty, mucoid, or muco-purulent in character and are frequently streaked with blood. In the more aggravated cases the sphincter may become relaxed and an involuntary dribbling of the discharges be permitted.

The **diagnosis** is at once established upon inspection through a speculum. Little reliance is to be placed upon a simple digital examination, although the educated finger may often appreciate the irregularities of surface caused by the ulceration.

The **treatment** is largely that of the chronic proctitis with which it is associated and of which it is a part. It should begin by enforcing a

bland, soft diet, and by placing the patient in the recumbent position, which should be maintained as much as possible to relieve venous congestion. The bowels, having been at first thoroughly cleared out by an active purge, should be kept relaxed thereafter by saline aperients. Temporary relaxation of the sphincters should be secured by overstretching: if a more prolonged relaxation is required, the sphincters may be divided by the knife. Copious irrigations of the rectum with mild stimulating and antiseptic fluids, such as solutions of boracic acid, sulphate of zinc, phenol, thymol, eucalyptol, etc., may be made twice daily or less frequently according to the apparent urgency of the case. Should there be much local pain and tenesmus, injections of laudanum and mucilage of boiled starch (ʒss to ℥ij) may be given at intervals of from two to four hours as may be required to give relief. Antiseptic and stimulating suppositories, as of iodoform gr. iij, balsam of Peru gtt. v, mixed with sufficient ol. theobrom. to make one suppository, may be used advantageously in cases in which the rectum is not too irritable to retain them. The injection of ointments containing similar ingredients may be used instead of suppositories. From time to time the ulcers may be exposed through a speculum and their surface pencilled over with a strong solution of nitrate of silver or touched with the solid stick. In conditions of diffused and multiple ulcerations the rectum, after having been irrigated, may be injected with several ounces of 10 per cent. emulsion of iodoform. In most cases, by the persistent and intelligent use of the measures above indicated, healing will be ultimately secured, but in occasional instances, more particularly of cases which by neglect have become extensive and of long standing, the ulcerative and inflammatory conditions prove intractable to all treatment as long as the fecal current continues to flow through the rectum. If the disease in such cases is limited to the lower three inches of the bowel, the entire diseased area of mucous membrane should be extirpated, and the sound mucous membrane brought down and sutured to the skin at the anal outlet. The technique of this procedure will be discussed in detail in connection with the treatment of hemorrhoids. If the area of mucous membrane is too high-reaching to be extirpated in this manner, an artificial anus should be established by left inguinal colostomy. The rectum, freed from the irritation of the fæces, may now be freely irrigated from the colonic opening above, and is placed in the most favorable condition for healing. Should the ulcerative processes still prove to be intractable, or should any marked stenosis of the rectal canal remain after their healing, the surgeon would be justified in extirpating wholly the diseased portion of the rectum according to the methods already described in connection with the treatment of malignant disease.

Papillomatous vegetations, when present, should be removed by the galvano-caustic wire or destroyed by the thermo-cautery point. To gain access to them, if dilatation of the anus and the use of the speculum is not sufficient, the cavity of the rectum may be laid open by a free backward incision of the anus and rectum—posterior linear proctotomy—as extensive as may be required to secure the necessary approach. The subsequent treatment of such a wound would be as already indicated in the section on Traumatisms of the Rectum.

Proliferative stenosing proctitis presents as its essential characteristic

a fibrous hyperplasia of the submucous connective tissue, which produces an induration and thickening of the rectal wall, and, by its contraction later, stenosis of the lumen of the bowel. All the normal elements of the rectal wall are fused together by the inflammatory products; the thickened mucous membrane is recognizable as a distinct structure, but it cannot be separated from the subjacent tissue; much of its glandular apparatus has undergone atrophy, and the normal cylindrical epithelium of its surface has become replaced by stratified flat epithelium: as the muscular coat is approached the changes become less marked, and the outer layer of muscular fibre may not become involved, but in exceptional cases the proliferative process may even extend beyond the rectal walls and invade the perirectal tissue. The thickness of the indurated wall will therefore vary much, reaching in extreme cases that of half an inch or more. The lower half of the rectum is the most frequent site of the affection. Ordinarily the length of bowel involved is relatively small, from one-third of an inch to one inch and a half, but occasionally the whole length of the tube up to the sigmoid flexure is affected.

The hyperplastic infiltration which engirdles the rectum produces, as a rule with few or no exceptions, a single point of coarctation. The mucous membrane at the level of the stricture is rarely ulcerated, presenting instead cicatricial changes as already described. Below this it generally presents the lesions of superficial chronic ulcerative proctitis, the two conditions being evidently different stages of the same pathologic process. Fistulæ opening into the bowel below the seat of constriction are frequent.

Above the contraction the mucous membrane is often ulcerated. The degree of contraction may become extreme, but complete obliteration of the canal does not take place, being prevented by the dilating power of the matters continually forced through it from above.

In its **etiology** this form of proctitis, in the great majority of cases, is a late stage of the more superficial ulcerative type.

The original lesions may not necessarily have been extensive nor attended by serious discomfort, but they have been sufficient to open the deeper tissues to the long-continued irritation and infective activity of the rectal contents, as a result of which the progressive neoplastic inflammation of the submucous tissue, with its fibrous hyperplasia and consequent sclerosis and contraction, has followed.

In a considerable proportion of the observed cases a history of antecedent syphilis has been ascertained (52 per cent., Allingham; 40 per cent., Hartmann, Juliusberger; 43 per cent., Poelchen; 18 per cent., Cripps), for which reason the lesion has been considered by many authorities to be, as a rule, essentially a syphiloma, notwithstanding the fact that it is rarely, if ever, affected by antisyphilitic remedies, and in the larger proportion of cases no history or other evidence of syphilis is present. The histologic examination of the diseased region, however, reveals only the condition of simple chronic inflammatory hyperplasia, quite different from that of the syphilitic type, not only in the cases without specific antecedents, but also in the large proportion of the cases with such history. It would seem, therefore, correct to conclude that in none of these cases is the proliferative process a syphilitic one, but rather that the syphilitic ulcerations, which may have occurred in the

rectum during the late secondary or early tertiary period, serve, as in other instances non-specific ulcerations do, to open the deeper tissues to the infection upon which the initiation of the hyperplastic process depends.

Cases of true gummatous infiltration of the rectal walls, with obliterative endarteritis, do occur, but they are extremely rare.

More frequently, but still relatively rarely, an inflammatory thickening of the rectal wall is tubercular in its nature. Such cases are generally associated with extensive superficial ulcerations of the adjacent mucous membrane and tuberculosis in other parts of the body.

The **symptoms** peculiar to this form of proctitis are those which are caused by the obstruction to the free passage of the intestinal contents from the gradually increasing stenosis of the rectal canal. To the symptoms determined by the antecedent chronic ulcerative proctitis, which will have existed in a variable degree for a prolonged period, in many cases extending to years in duration, gradually and insidiously those indicative of obstruction are added. An increasing difficulty in defecation is experienced; fecal accumulations dilate the upper part of the rectum and the sigmoid, provoking reflex tenesmus and colonic cramps; gaseous distention of the colon is troublesome; diarrhœal crises occur at irregular intervals, alternating with obstinate constipation. There may be a frequent desire to go to stool, especially in the early morning, with urgent colicky pains, but the efforts at evacuation, though forced and long continued, may bring away but scanty fecal matter, often merely a small amount of muco-pus. The discharges often present the appearance of little hard balls or of fecal crumbs, small broken fragments of inspissated fæces, floating in more or less fluid. In less aggravated cases, especially when the point of stenosis is some distance above the anus, fecal matter, having been forced through the stricture, may regain the usual form and be expelled as a natural bolus. When the constriction is near the anal outlet it may be forced down through it by the violent straining effort at stool, and the fæces be voided at once in thin tape-like strips. Such obstructive symptoms in their various degrees may persist for a prolonged period of time, even for years, before the general health seriously suffers. By the systematic use of laxatives and enemata the fecal retention may be in a great measure prevented for a long time; but the hypertrophic and stenosing process is a steadily advancing one, and sooner or later determines mortal accidents. Occasionally complete obstruction occurs from impaction in the narrowed canal of some hard body, such as a mass of inspissated fæces, fruit-pits, or the woody residue of certain vegetables. More frequently attending ulcerations and abscesses introduce complicating conditions of sepsis, of suffering and exhaustion that, if unrelieved, ultimate in death independent of any obstructive accident.

The **diagnosis** of rectal stenosis due to chronic inflammatory hyperplasia of its walls is not usually attended with difficulty. Obstruction to the passage of fæces through the rectum may be caused by the pressure of tumors arising from other pelvic viscera or from the framework of the pelvis itself: its more movable upper portion may become so kinked by peritoneal adhesions, or at any portion of its course massive perirectal inflammatory exudates may so compress it, or bridle-like adhesions may

so cross it, as to produce any grade of obstruction. Cicatricial contraction following accidental wounds or burns or extensive operative removals of tissue or annular ulcerations may produce their peculiar valvular diaphragmatic constrictions. Each of these conditions, however, has had its special history, and in none of them is present the diffused thickening and the rigid contracting cylindrical canal which marks hypertrophic stenosing proctitis. Rectal stenosis due simply to the contraction incident to the healing of an ulcer is very rare. Such a process uncomplicated would result in the formation of an irregular band projecting sharply into the lumen of the bowel. But in most cases such ulcers have in the course of their history become points of departure for more or less diffuse inflammatory hyperplasia of the submucous tissue, to the contraction of which the later stenosis is in greatest measure due. Annular carcinoma in its earlier stages may be confounded with hypertrophic proctitis—a mistake which is particularly regrettable, since it may lead to so long a postponement of extirpation of the diseased segment of the bowel that its radical removal has become impossible. Carcinoma will not have been preceded by the long history of chronic ulcerative proctitis which, as a rule, attends the development of an inflammatory stenosis. The ulcerative cavities which result from the breaking down of carcinoma when the disease has advanced to that stage declare at once the nature of the new growth, so that it is only in the preulcerative stage that the true nature of a carcinomatous infiltration would be likely to escape recognition, provided careful local exploration has been made. It is to the neglect of the exploration of the cavity of the rectum that most diagnostic errors are due. However, should in any case, after careful examination, a doubt remain as to the true character of the inflammation, the benefit of the doubt should be given to what would be the more immediately threatening condition and the case treated as if it were malignant.

Atony of the rectum and sigmoid flexure, leading to fecal accumulations, may produce symptoms of obstruction. Digital exploration of the rectum suffices to establish the diagnosis.

Congenital narrowness of the lower rectum short of complete atresia may occasionally be met with. This is a developmental defect, and may exist as a simple valve-like diaphragm or as a more or less long uniform diminution in the calibre of the intestine. It is likely to become recognized before adult age is reached: it is unattended by any inflammatory or ulcerative complications. It is chiefly characterized by extreme constipation. Spasm of the circular fibres of the rectum may temporarily increase the stenosis of an organic stricture. Uncomplicated spasmodic constriction of the rectum, sufficient to produce obstruction to the passage of the rectal contents, is not imaginable.

Stenosis of the lower rectum, in which position the great majority of non-malignant constrictions occur, is at once detected by digital examination. In conducting this examination any distention of the stricture by boring with the finger must be absolutely refrained from on account of the possibilities of laceration and fecal extravasation. Examinations of the upper rectum beyond the reach of the finger are best effected by flexible rubber bougies of graduated sizes, such as those which are known in the United States as Wales's bougies.

These are hollow, so that through them water can be injected into the cavity of the rectum in advance of the tip of the bougie, whereby any valvular folds of the mucous membrane which might arrest the progress of the instrument are effaced and its ongliding facilitated. Whalebone or flexible tin sounds, surmounted by olive-shaped ivory tips, are preferred by some surgeons for such explorations, since the bulbous head, once having passed through the constriction, shows resistance again as it is withdrawn as soon as it is engaged in the upper margin of the constriction; thus the extent of the stricture may be quite well determined. Errors as to the existence of high-lying strictures have frequently been made, owing to failures to eliminate by care the possible source of error which the normal folds of the mucous membrane and the projection of the sacral promontory present. In investigations as to the existence of high-lying strictures anæsthesia, followed by illumination of the cavity of the rectum through a tubular speculum while the patient is in the knee-chest position (Fig. 291), is of especial value in eliminating sources of error.

Treatment.—The constriction of the rectum caused by chronic proliferative proctitis never retrocedes spontaneously, nor can it be favorably influenced by any internal medication. Its obstructive effects may be diminished by keeping the stools soft and diffluent by the use of laxatives and of such food as will leave the minimum of fecal residue.

Ulcerative and fistulous complications should receive their appropriate treatment, and thus the painful conditions be relieved as much as possible. The treatment of the stricture itself may be palliative or radical. In the first rank of palliative measures stands gradual dilatation with bougies. The soft elastic bougies of Wales should be employed. Great gentleness and care should be exercised in their use, and all attempts at rapid dilatation must be refrained from. Only such size as can readily pass through the stricture should be chosen. The size of the bougie should be increased from time to time as dilatation is accomplished. A few minutes, five to ten, at each insertion is as long a time as a bougie should be left in place, and the frequency of its introduction should not be greater than once in two or three days at first, the intervals becoming more prolonged after considerable dilatation has been effected.

In many cases much relief follows the long-continued and systematic use of bougies. The improvement secured in such cases may usually be maintained indefinitely by an occasional use of the bougie at intervals, in the most favorable cases, of some weeks. Prolonged neglect of the use of the bougie, however, is sure to be followed by a gradual renewal of the stenosis.

No credence is to be given to the enthusiastic claims of a special absorbent power obtainable from an electrolytic current applied through a "bougie" electrode.

Internal proctotomy, consisting of multiple superficial incisions or nickings made at various points about the circumference of the indurated ring, has frequently been used as an adjuvant to the bougie dilatation. The benefits are undeniable, but the incisions are to be made with caution, lest they extend through the wall of the intestine and permit fecal extravasation into the perirectal tissues.

External linear proctotomy consists of free longitudinal incisions through the whole thickness of the stricture, and thence through the sphincter and anal outlet, extending into the perianal tissues sufficiently to ensure that the broadest portion of the incision is below and no retention of fecal matters in the wound is possible. This will temporarily relieve obstructive symptoms, and in exceptional instances is reported to have resulted in permanent cure. Usually, however, the stricture again becomes apparent within a short time after the wound is healed. It substitutes for the time being a condition of incontinence for one of obstruction. It always entails prolonged suppuration, and may degenerate into the condition of an extensive indolent ulcer. It may be resorted to when bougies have been found ineffectual or intolerable or when more radical measures seem inexpedient. The direction of the incision in most cases should be in the median line, directly backward toward the coccyx.

Colostomy may be imperative for the relief of threatening obstructive symptoms due to sudden blocking of the stenosed canal which cannot be readily or safely remedied by proctotomy. It is especially indicated when the attending ulcerating and suppurative or fistulous complications are extensive, contraindicating direct attack upon the rectum, and when a temporary diversion of the fecal current away from the rectum is desirable. Later, when these conditions have disappeared and when the general health of the patient has become improved, dilatation or removal of the stenosed portion of the intestine may be undertaken for the purpose of restoring the natural channel and allowing the artificial anus to be closed.

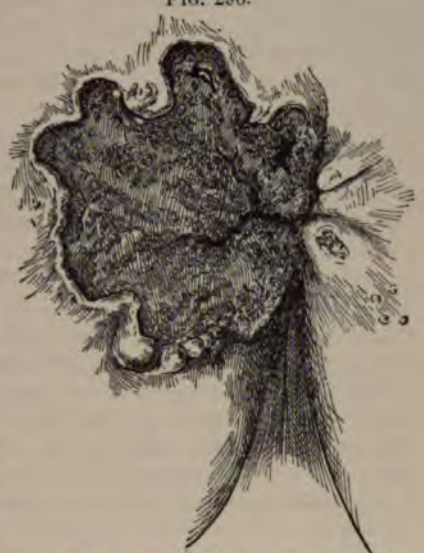
Excision of the affected segment of the intestine is the one *radical* method of treatment available, and in the more extreme and intractable cases should be resorted to. Long and high-reaching strictures are especially rebellious to any less radical methods of treatment. Stricture near the anus not complicated by perirectal indurations may be removed without injuring the sphincters, as in the operations described later for the removal of hemorrhoids. In the more aggravated cases full amputation of the lower end of the rectum will be required. The higher-lying stenosis calls for resection of the diseased segment, followed by suture. The technique of these operations is identical with that required for the removal of malignant growths of the rectum, in which connection it has been fully discussed (page 489).

Ano-rectal Tuberculosis.—Tuberculosis may develop in the ano-rectal region, either in the subcutaneous or submucous tissue, or in the skin. Tuberculosis of the connective tissue leads to abscesses and fistulæ, and has been mentioned in connection with those conditions. The opening of these abscesses may be followed by more or less necrosis of the overlying skin and the degeneration of the condition into a frank tuberculous ulcer. (See Fig. 296.) These are not primarily tuberculosis of the skin. Primary tuberculosis of the skin about the anus, comparable to lupus of the face, is relatively rare: it is most often associated with lupus of the external genital organs in woman—the *esthiomène* of the French. Such ulcers present the peculiar character of tuberculous ulcerations.

The local affection first manifests itself by the formation of super-

ficial tubercles, which coalesce. By subsequent necroses an ulcer results which extends peripherally, surrounded by a zone of infiltrated connective tissue. Cicatrization is frequently present at one part while the ulcer is extending at other points. The extent of the infiltration and the destruction of tissue may vary greatly. In the most aggravated cases the perirectal tissue may become so extensively destroyed as to cause the end of the rectum to project as an isolated mass in the middle of the excavation. The affection is most frequent in young persons. Tubercular inflammation at the anal margin, in which the proliferative process is marked and the tendency to necrosis is delayed, may result in the production of condylomatous masses which may be confounded with carcinoma or with venereal disease. A similar tubercular infiltration of the walls of the rectum at any part of its course may also occur, and has already been noted in the description of chronic stenosing proctitis. The hyperplasia caused by the tubercular infection increases manyfold the thickness of the walls of the intestine and produces marked stenosis. Its characteristics are more those of a new growth than of simple inflammatory infiltration. It tends to invade neighboring tissues and to break down into abscesses, as do similar deposits in other regions of the body.

FIG. 296.



Tuberculous ulcer of the anus (after Esmarch).

Superficial tubercular ulcerations of the rectal mucous membrane are not infrequent as epiphenomena in the course of intestinal tuberculosis. Every degree of superficial infiltration and ulceration may attend the deeper stenosing hyperplasia.

The **diagnosis** of the various forms of ano-rectal tuberculosis is usually indicated by the evident existence of advanced tuberculosis of other organs. The tissues forming the base and borders of the ulcers present the peculiar conditions characteristic of tubercular degeneration. There is rarely present any underlying induration. The borders are quite clean cut, irregularly eroded, in places undermined; their surface exudes a scanty muco-purulent secretion; the sensations provoked by them are those of uneasiness and discomfort rather than positive pain. The diagnosis may be established by the demonstration of the special microscopic characteristics of tuberculous inflammation in a portion of the base and the margin excised for the purpose, and may be further confirmed by inoculative tests.

In the **treatment** the greatest importance attaches to general hygienic and supporting measures. Locally, stimulating and detergent applications are indicated. Vigorous curetting, followed by iodoform dressing,

alternating with balsam of Peru and naphthalin, will promote cicatrization, and in those cases in which the local disease is limited and infection of other organs is not far advanced, may effect a cure. Formal extirpation can rarely be indicated. Abscesses should be opened and fistulous tracts divided. Stenosis will be treated by bougie dilatation, proctotomy, or colostomy as the especial conditions may seem to indicate. Despite all treatment, the lesions of ano-rectal tuberculosis often persist until death from other lesions occurs.

Syphilitic Lesions of the Anus and the Rectum.—*Chancre* of the anus is not very rare, being met with more frequently in women than in men. Its essential characteristics are the same as those of chancre elsewhere, but, owing to the irritations to which it is subjected by its location, it tends to pursue a more chronic course, and is likely to become complicated by inflammatory and ulcerative epiphenomena. An ultimate degeneration into a condylomatous condition is not infrequent. More rarely intrarectal chancres have been detected. Non-syphilitic venereal ulcers (anal chancroids) should be mentioned in this connection. These are much more frequently met with, especially in women, being due to auto-inoculation from similar sores of the vulva or from accidental contact with the penis during coition, even when sodomy has not been practised. They do not differ from similar ulcers elsewhere except in the greater tendency to chronicity and phagedena which their position provokes.

Mucous patches are prone to develop at the anal verge in the secondary stage of an attack of syphilis. Presenting themselves at first as slightly elevated excoriated plaques of skin about the anus, they undergo proliferative and ulcerative changes. Broad, wart-like masses (condy-

Fig. 297.

Syphilitic condylomata of the anus (proliferating mucous patch).

lomata) develop which are seamed with fissures, and from the surface of which a very offensive muciform secretion exudes. They readily become ulcerated, degenerating into shallow, indolent ulcers, which take the place of most of the elevated disk, irregular remains of which, however, may still persist as hypertrophic masses about the ulcer. Fig. 297,

redrawn from one of the plates of Ball, shows well the broadly-flattened warty growths thus developed.

The local treatment of syphilitic condylomata consists in the adoption of means of keeping the parts dry and clean and promoting the cicatrization of ulcerated surfaces. Frequent irrigations with mild antiseptic fluids should be practised, and pads of absorbent cotton should be kept between the folds of the nates. The surface of the vegetations after each cleansing should be freely dusted with a powder composed of equal parts of powdered starch and calomel or aristol. If the vegetations are very exuberant, they should be cauterized by carbolic acid or chloride-of-zinc paste or some other active escharotic. Energetic systemic antisyphilitic treatment should in all cases be carried on at the same time with these local measures.

In the late secondary and early tertiary periods of syphilis *ulcerations* frequently appear in the rectum which are quite as characteristic as are their congeners in the pharynx or post-nasal space. They are chiefly located near the anus, may be confined to the cavity of the rectum, may involve the anal orifice, or may extend outward upon the surrounding integument. They present well-cut borders, not undermined nor indurated. Their base is smooth, and secretes quite abundantly a purulent, sanious matter. Extensive destruction of tissue has in some instances resulted from them. Other syphilitic lesions elsewhere may be present that give a clue to the specific nature of the rectal disease or the earlier history may be clear. In their treatment the local stimulating and antiseptic treatment appropriate to all ulcers in this region should be energetically applied, together with general specific treatment. They are, however, often rebellious to treatment, and in their more aggravated forms may require to be freed by colostomy from the continuous irritation of the fecal current before cicatrization can be secured. They are among the most frequent lesions from which develops the chronic proliferative stenosing form of proctitis, as has been pointed out in the section devoted to that form of inflammation.

Rarest of all the syphilitic affections of the rectum is a circumscribed gumma forming in the rectal wall and producing the usual symptoms of a neoplasm. Literature contains records of but three or four well-authenticated cases of this kind, and men of long and extensive observation in the field of syphilis have never met with it.

Congenital syphilis presents itself most frequently as a sort of erythema about the anus with numerous fissures, easily confounded with the irritation often caused in infants by contact with the urine and fæces. If neglected, these develop after some months into shallow ulcerations from which a serous secretion oozes. The presence of other syphilitic lesions upon other parts of the body makes the diagnosis easy.

HEMORRHOIDS (*Piles*).—Varicose dilatation of the ano-rectal veins is a very common affection. From the projecting lobulated masses which frequently result the common term "piles" is given to them; from the tendency to bleed that they manifest they gain the name of hemorrhoids, from *αἱμορροίς*, a flow of blood. According as the swelling is located externally or internally to the muco-cutaneous junction they have been classified as *external* or *internal piles*. Clinically, this division is just, but pathologically it is unimportant, as the essential

changes are identical in each location, and most frequently the two varieties are associated in different degrees of development.

The varicosities often begin to develop in early life, even in infancy, but it is rare that they assume proportions requiring surgical attention before adult age is reached. In many cases intercurrent conditions have been the causes of their aggravation and development into a troublesome affection. Such exciting and aggravating causes may be constipation, abuse of cathartics, sedentary habits, the various inflammatory and neoplastic affections of the rectum or of the adjacent pelvic organs, pregnancy, and such cardiac and hepatic affections as may produce portal congestion. The two sexes are equally subject to them.

The beginning of the hemorrhoidal varicosity is usually at the point of anastomosis of the radicles of the two sets of veins, inferior and superior; that is, where the portal and caval systems communicate in the narrow zone just within the anal orifice. Plate VI., Figs. 1 and 2, from dissections by Otis of Boston, show well the arrangement of these veins at the rectal outlet. Should the dilatation be confined to the radicles of the inferior hemorrhoidal veins, an external pile only results (Plate VI.). Occasionally the varicose affection is not limited to the radicles in the submucous coats of the intestine, but extends in a varying degree to the more distant trunks and plexuses. As far as the pile is concerned, however, the lesion is confined to a narrow zone of the mucous and the submucous tissue. In the simplest form of the lesion the venous radicles present ampulla-like, fusiform, or contorted dilatations. The aggregation of a group of these dilatations, distended with blood, produces the hemorrhoidal tumor. A series of such swellings, more or less fused together or as isolated lobulated masses, may surround the outlet of the bowel. The accompanying plate (Plate VII., Fig. 2), reproduced from Quénu and Hartmann,[1] show the resulting anatomical condition. The process not infrequently involves both sets of radicles, resulting in the development of a double concentric chaplet of piles. This is well shown in the accompanying chromo-lithographic plate, which was drawn from one of my own patients just previous to proceeding to extirpation (Plate VII., Fig. 1).

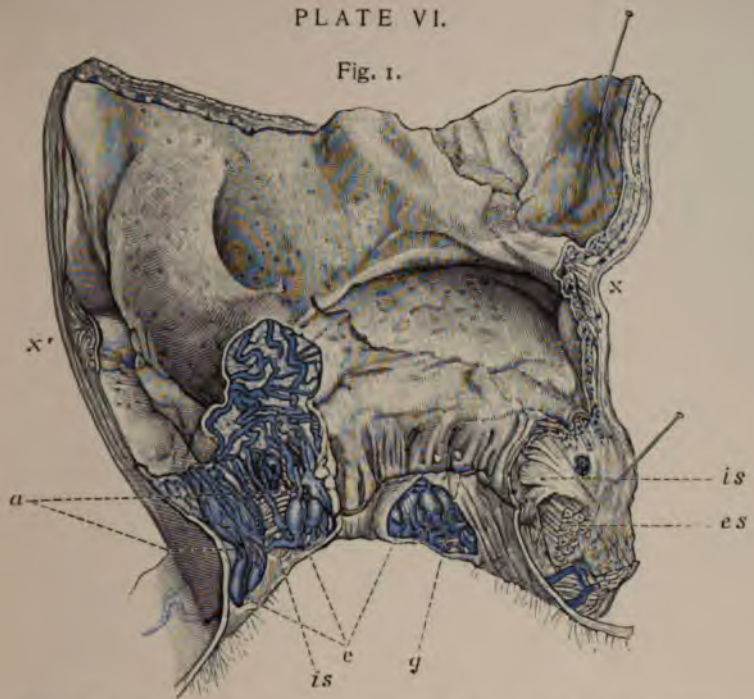
The superficial capillaries of the mucous membrane are also prone to become dilated, and this nævus-like, hemorrhagic degeneration of the mucosa may be the predominating lesion.

The microscopic anatomy of a pile shows varying conditions of the dilated veins: in some cases the vein tunic will be thickened from inflammatory hyperplasia; more frequently the vein-wall is attenuated, sometimes being reduced to a thin layer of fibrous tissue. In some places the proper walls of the veins are not recognizable, but there remain simply irregular cavities in the midst of a fibrous stroma—a true cavernous angioma. On the other hand, obliteration of some of the cavities may have occurred through thrombosis and endophlebitis. In the accompanying plates (Figs. 57 and 58), drawn by Dr. J. P. Warbasse from sections of piles removed by operation, these various changes are clearly shown (Plate VIII.). The mucous covering of the internal pile presents the lesions of chronic inflammation: in parts it is thickened by glandular and fibrous proliferation and cell-infiltration, while

[1] *Chirurgie du Rectum.*

PLATE VI.

Fig. 1.

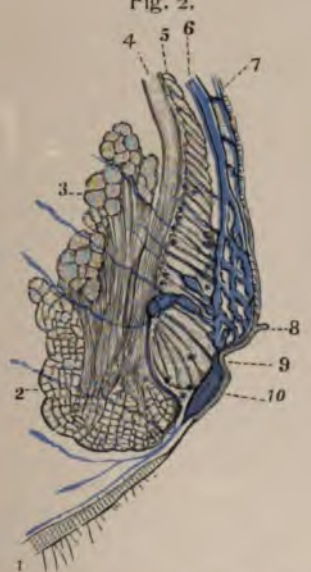


Dissection showing the Arrangement of the Ano-rectal Veins. (OTIS.)

An alcoholic preparation of the lower rectum opened lengthwise in the median line anteriorly, a portion of the mucous membrane and muco-cutaneous tissue having been removed to expose the internal and external hemorrhoidal veins.

x, *x'*. The lowermost *plica transversalis recti*, one of a series of ineffaceable transverse folds that are present in the rectum, with considerable variation as to their number and distinctness in different individuals. *a*. The short and narrow anastomoses between the dilated portion of the internal hemorrhoidal veins above and the dilated portion of the external hemorrhoidal veins below. *e*. Dilated external hemorrhoidal veins. *g*. The sulcus or groove that encircles the anal orifice. Just above are to be seen the *columnæ* and *lacunæ* of Morgagni. *i s*. Internal sphincter. *e s*. External sphincter.

Fig. 2.

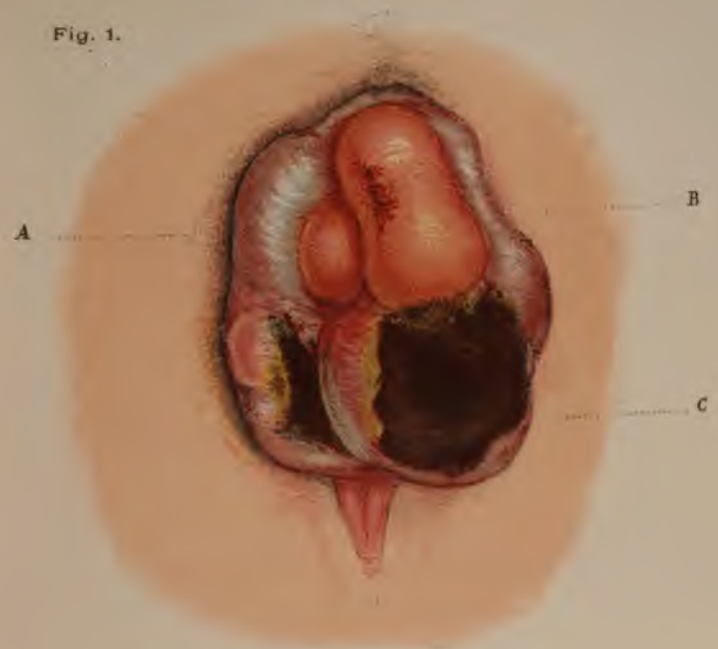


Longitudinal Section through the Rectal Outlet, semi-diagrammatic. (OTIS.)

1. Skin. 2. External sphincter. 3. Levator ani. 4. Longitudinal muscular fibres. 5. Circular muscular fibres terminating in the internal sphincter. 6. Internal hemorrhoidal veins in the submucosa. 7. Mucous membrane. 8. One or more papillæ often seen on the bases of the columns. 9. The ano-rectal groove which is produced by the distention of the internal veins just above it and the external veins just below it. In the dead body, where the veins are empty, the groove will not be apparent. 10. Dilated portion of an external hemorrhoidal vein.

PLATE VII.

Fig. 1.



MIXED HEMORRHOIDS.

A. Œdematous External Hemorrhoid.
B. Protruding Internal Hemorrhoid.
C. Large Mixed Tumor, with Superficial Slough.

Fig. 2.

Dissection showing Hemorrhoidal Varicosities. Veins infected with tallow are colored Blue; Arterial twigs in Red. (Quenu and Hartmann.)

from distention and erosion areas of thinning, even of ulceration, may coexist. The cutaneous covering of the external pile as the result of continual irritation often becomes thickened and elongated, and ultimately develops into a flabby tab.

In all piles the venous element is chiefly involved: the arteries play no part in their formation, but in certain more aggravated and long-standing cases a distinct enlargement of the arterial twigs which supply the affected segment of bowel occurs.

The tissue-changes just described are confined to the submucous tissue and the overlying mucosa. Abundant loose connective tissue intervenes between the pile-mass and the muscular tunic. The tumor projects in the cavity of the bowel and tends to elongate and become pedunculated, pressing downward upon the sphincters and ultimately protruding through them during defecation. At first this prolapse only occurs from unusual pressure and straining, but the elongation of the pile may become more pronounced and the sphincter more relaxed, with the result that ultimately the pile habitually protrudes or at once descends whenever any abdominal pressure, as in coughing or lifting, is exerted.

Piles are prone to acute *inflammatory crises*, which are essentially attacks of circumscribed phlebitis and periphlebitis due to their infection from the pathogenic organisms of the region. The result of such an attack may be obliteration of the varix and cure of the pile. Abscesses and fistulæ are not uncommon sequelæ. The infection more frequently determines a partial thrombosis, often of the deeper ampullæ only, and the result of the attack is simply to aggravate the pre-existing condition by adding to it indurated knots and more or less persistent chronic inflammatory œdema and hyperplasia. Limited superficial necroses and ulcerations are not infrequent.

Bleeding is so frequent a complication in the course of a pile that as a symptom it dominates popular thought in connection with the affection. More frequently it is a capillary oozing from the easily-lacerated dilated vessels of the mucous membrane, but it may occur from a minute opening into a cavernous blood-space or from vessels opened by ulceration. The last-named conditions may give rise to great losses of blood, even to fatal anæmia. Usually the amount of bleeding is slight and is provoked only by defecation. It may recur with each stool for a time, and then cease, only to recur again after some interval. The daily losses of blood, though slight, when persistent for a long period may cause profound anæmia, suggestive of the cachexia of advanced malignant disease. The tendency to bleeding is favored by prolapse of the tumor.

The **symptoms** caused by piles, other than those incident to prolapse, the inflammatory crises, and the bleedings already mentioned, are not well marked. Some feeling of pressure at the anus, some pain in defecation, some discomfort when sitting down, comprise the list. In the absence of the complications named they form simply an infirmity more or less troublesome according to the degree of the development of the tumors and the social state of the patient. Only in a small proportion of cases do they attain such development as to call for operative surgical treatment.

Diagnosis demands in all cases inspection by the surgeon. Any abnormality appearing at the anus, especially if it is attended by bleeding, is usually ascribed by patients to piles. Hence the importance of actual inspection before accepting such ready-made diagnoses.

To recognize *external hemorrhoids* is generally easy. The cutaneous folds are regularly arranged about the circumference of the anus. The absence of chancrous ulcers and other venereal manifestations differentiates them from condylomata. The possibility of carcinomatous vegetations protruding at the anus being mistaken for external piles vanishes upon the most cursory examination. When an inflammatory crisis is under way, the tumors become turgid and painful, attended with some tenesmus and sphincteric spasm. Upon inspection one or more livid, distended, exquisitely sensitive tumors of the size of a large pea to that of a small nut are seen at the anal margin, together with œdema of the adjacent folds.

Internal hemorrhoids are readily recognized when they are turgescent and protrude. The soft elastic masses which they form have nothing in common with the firm glandular or fibroid tumors of polypi or the irregular indurations of malignant neoplasms. The uniform circular fold of simple rectal prolapse ought never to be confounded with the lobulated masses of piles. When the tumors do not protrude, if the patient strains down as if at stool and the anal borders be separated by the fingers, they will come into view, and sometimes be made to protrude. This may be facilitated by the administration of an enema of warm water a few minutes before the examination. A more perfect examination may be made under anæsthesia. When the sphincters are dilated the whole pile-bearing area rolls out into full view.

Treatment.—In a large class of cases merely palliative treatment is required. The general health is to be cared for: other affections which may have aggravated or excited the troublesome manifestations of the piles are to be inquired for and relieved; regularity in the function of defecation is to be established and a soft condition of the stools maintained. Local douching of the anus after each stool with cold water is of value in overcoming the tendency to relaxation of the sphincters and in promoting contraction of the swellings. The use of harsh and irritating materials to wipe the anus must be avoided. The lesser congestive and hemorrhagic symptoms may be relieved by soothing and astringent ointments and suppositories. Ulcerative complications call for the treatment already recommended for other forms of ulcerative proctitis. Repeated and considerable bleeding, frequent occurrence of painful crises, trouble some tendency to prolapse or irreducibility of the prolapsed mass, call for extirpation.

External Hemorrhoids.—When the cutaneous tabs which develop over the adjacent varicose veins interfere with the ready cleansing of the part or are prone to become irritated, simple excision is called for. The little tumor is gently put upon the stretch by toothed forceps and cut away at its base with bistoury or scissors. The small wound left is sutured or left to granulate.

When inflamed, instead of limiting treatment to the use of fomentations, as of lead and opium, it is better to incise the small thrombosed tumor that presents and turn out the blood-clot by gentle pressure. In

many cases a more speedy and radical cure will be secured by excising outright the whole of the inflamed mass. One or two properly-applied sutures will control any bleeding, and a portion of the wound may be left open, filled for the time being with a bit of iodoform gauze as a drain.

Internal hemorrhoids may be excised with a bistoury and the wound sutured, or they may be removed by the actual cautery, or they may be ligated at their base and the greater part of the strangulated mass cut away. Whatever method is resorted to, over-distention is always to be employed as a preliminary procedure. The bowels should have been emptied by a cathartic the previous day, and the lower bowel should have been cleared out by an enema given at least eight hours before the time of operation. The patient should be placed in the exaggerated lithotomy position or in the knee-chest position. Full anæsthesia must be made. After dilatation of the sphincter and full inspection of the extent of the varicose degeneration has been made the surgeon will determine the exact operative procedure best suited to the case. The more aggravated forms of hemorrhoids which, in tumor-like angiomatous masses coalesce so as to involve nearly the whole circumference of the lower rectum, are best treated by systematic extirpation of the whole pile-bearing segment of the mucous membrane. This method is known as the method of Whitehead. In the less-generalized forms of piles, where a certain isolation and pedunculation of the tumors exist, each pile may be separately extirpated. Piles that are complicated by much inflammation of the mucous membrane about their base, or which are gangrenous, are best destroyed by the actual cautery. A description of the technique of typical operations by excision, by ligation, and by cauterization is subjoined. In many cases combinations of these various procedures may best be employed.

Excision of Pile-bearing Segment.—The patient being in the exaggerated lithotomy position and the sphincter having been dilated, an incision is carried around the entire circumference of the bowel at the mucocutaneous junction down to the external sphincter. Care is to be exercised not to cut away any of the skin, but to preserve all its irregularities. It is not always easy to recognize at once the muscular fibres of the sphincter, which are likely to be flabby and atrophied. Before any deepening of the dissection is done the muscle must be clearly identified. When this has been secured at any point it is easy thereafter to keep within it, and the dissection may proceed more rapidly. Traction is made upon the ring of mucous membrane as it is freed from the muscular layer by the fingers and scissors until the enucleation has been carried up beyond the diseased area of mucous membrane. This will usually be from an inch to an inch and a half in height. Care must be taken at first to hug closely the inner surface of the sphincter muscle, and thus to keep outside the vascular tissue of the tumor proper, lest an undesirable amount of hemorrhage occur and the enucleation be embarrassed. When, however, at any point the sound tissue beyond the tumor has once been reached, the further enucleation may be readily and safely accomplished by working in a circular direction around the bowel from this point, and thence downward to the anal margin. It is important that the dissection be pushed upward well beyond the diseased portion at all

points, so that the final transverse section of the bowel shall be made through healthy mucous membrane. The healthy mucous membrane having been reached, the diseased segment is to be cut away by a squarely transverse cut, and the edges of the healthy stump sutured to the skin below by many fine silk sutures. In order to keep control over the stump the division and suturing are to be done through only a part of its circumference at a time: at nearly every cut a small submucous arteriole will spurt, which must be clamped and tied before the suturing to the skin is done. Thus, advancing step by step, the final complete suture is accomplished.

At first the line of sutures will be well outside the anus, but as time passes the rectal walls again regain their tonicity and retract upward somewhat; the sphincters regain their power of contraction, and the skin adherent to the surface of the external muscle is drawn upward, until finally the suture-line will be found to have disappeared within the anus. This operation in ordinarily skilled hands is somewhat tedious and is often bloody. It should not be undertaken by one unaccustomed to delicate operative manipulations, nor without the presence of good assistants, good light, and suitable instruments. The result, however, in appropriate cases is an ideal restoration of the outlet of the rectum to a healthy condition.

By Ligature.—The sphincter having been dilated, the pile is seized with a volsellum forceps and drawn down. Then with a pair of sharp scissors it is separated from its connection with the muscular and subcutaneous tissues upon which it rests, the cut being made in the sulcus where the skin and mucosa meet and carried upward on either side in the long axis of the bowel to such a distance that the pile is left connected only by an isthmus of vessels and mucous membrane. This isthmus is now tied by a silk ligature as tightly as possible. If the pile be large, a portion of it may now be cut off, taking care to leave a sufficient stump to prevent the ligature from slipping off. Each pile in turn is treated in this way.

If the base is broad, it may be transfixed by a needle bearing a double ligature and the two halves separately ligated. This is the quickest and safest method of dealing with well-formed piles which do not involve the entire circumference of the anus. It is especially applicable in the case of anæmic and aged patients.

Clamp and Cautery.—The sphincter having been dilated, the pile is seized with volsellum forceps and drawn down, and its base incised at the junction of the skin and mucous membrane, as in the operation with the ligature. A clamp is applied to the base, strongly compressing it: the greater part of the pile is cut away with the scissors and the stump is then seared with the actual cautery, after which the clamp is removed. The eschar falls in a few days, leaving a granulating surface to heal. The use of a clamp is simply to secure temporary hæmostasis until the cautery can be applied.

After-treatment.—A suppository of opium and hyoscyamus (morphiæ sulphatis, gr. $\frac{1}{4}$; extracti hyoscyami, gr. j) should be placed in the rectum at the conclusion of the operation. On the second day after the operation a mild laxative should be given; immediately preceding the evacuation an enema of olive oil should be given to facilitate

the passage. Necessary care should be taken to prevent subsequent constipation.

Interstitial Injections.—Obliteration of hemorrhoids by injecting into their tissue-spaces coagulating and irritating fluids, such as carbolic acid, chloride of zinc, subsulphate of iron, etc., have been much in vogue among a class of charlatans as a means of treating piles "without the use of a knife or ligature." In many cases much improvement is secured by these means; in others, abscesses, extensive gangrene, and even pyæmia, have resulted. The method has nothing to recommend it to the adoption of the educated surgeon.

PROLAPSUS.—The looseness of the submucous connective tissue permits the mucous membrane at the anal outlet to be readily everted in some degree whenever the sphincters are relaxed. In a slight degree this may attend any strained defecation, but the protruding folds are at once retracted within the anus upon the cessation of the extruding force. This normal eversion may become exaggerated in various degrees, resulting in a mass that either protrudes continually through the anus or rolls out at the least straining down.

The resulting tumor is a soft conical mass, whose florid mucous covering presents uniformly transverse folds encircling it. At its

FIG. 298.

Prolapse of the rectum (Gross).

apex a crater-like depression leads into the canal of the bowel. (See Fig. 298.)

In its lesser degrees rectal prolapse is most frequently met with in infants and young children, in whom it is brought on by the prolonged straining attending constipation, phimosis, polypi, or the irritation of worms. In adults it may follow the straining provoked by stone in the bladder, stricture of the urethra, or enlarged prostate. In adolescence it occasionally occurs from no other apparent cause than an undue relaxation of the submucous connective tissue, with weakness of the anal leva-

tor and sphincter muscles. A relaxed condition of the muscular and fibrous structures constituting the floor of the pelvis predisposes to prolapse of the rectum and conduces to its perpetuation when it has once occurred. The persistence of the protrusion in turn causes greater relaxation and atrophy of all the musculo-fibrous apparatus surrounding the rectal outlet. If neglected, it tends to increase in volume and in some cases attains enormous dimensions.

In its earlier and less severe forms the prolapsing mass involves only the mucous membrane, which has been dragged away from the muscular coat by the yielding of the submucous connective tissue. Such a prolapse tends to reascend spontaneously, but it may be caught and held by the irritated sphincter and persist as a congested and œdematous tumor. As the amount of prolapse increases all the coats of the bowel become involved in it. Protrusions of much size contain more or less of the peritoneum, and in aggravated cases loops of intestine or the uterine appendages may be contained in the herniated mass. As long as the prolapse involves only the mucous membrane it is termed a *partial prolapse;* when all the coats become dragged out it is a *complete prolapse.*

The ordinary prolapse begins at the anal verge, and the higher parts become gradually dragged upon and turned out. In rare instances, however, the protrusion consists of a fold of the higher rectum which has become invaginated and forced downward until it escapes through the anus. Occasionally, as has been noticed in the section treating of intussusception, an ileo-colic invaginated mass has been propelled along the whole length of the large intestine until it has protruded through the anus. In the latter case the examining finger of the surgeon will detect the sulcus which intervenes between the surface of the protruding mass and the outlet of the rectum. In the ordinary prolapse the surface of the tumor is continuous at its base with that of the anal orifice, without any intervening sulcus.

Treatment of prolapse of the rectum includes reduction of the protrusion, removal of the exciting cause, and the restoration of the normal tonicity of the parts.

Reduction of the protrusion by appropriate manipulation and pressure is easily done, except in recent cases in which the mass, swollen by congestion and œdema, is tightly gripped by a spasm of the sphincter. In such a case the administration of an anæsthetic is all that is required to remove the difficulty.

Whatever condition may be present that tends to excite much straining in defecation or urination must be remedied. Stone in the bladder and prostatic or urethral obstruction require their appropriate treatment. Constipation, worms, polypoid and hemorrhoidal affections, if present, must be remedied or removed. Relaxation of the anal outlet may be temporarily counteracted by the pressure of a suitable pad held in place by a T-bandage or a truss, and by care to defecate and urinate only while in the recumbent position. Whenever any protrusion occurs it should be replaced at once. Locally, cold douches, both externally to the anus and as internal enemata, should be given after every stool. Subcutaneous injections of a moderately irritating character into the perirectal tissue may be made, and in cases of moderate relaxation are

sometimes of decided benefit. For such injections may be recommended ergotine, gr. ij rubbed up in half-drachm of a 2 per cent. solution of carbolic acid. Unless special care is taken to cleanse the surface of the skin where the injection-puncture is made infection and subsequent abscess are quite likely to follow such injections.

Cases that are not cured by these methods of hygiene and simple local applications must be subjected to more radical operative measures. The indications are to overcome the relaxation of the submucous connective tissue and to restore tone to the levator and sphincter muscles, or to supplement such tone by plastic narrowing of the anal orifice. Of the various methods which have been suggested for effecting these ends, there are two which may be described as of established value—namely, (1) longitudinal cauterization of the prolapsed mucous membrane, and (2) excision of a wedge of tissue from the patulous orifice followed by suture. For yet more inveterate cases the total ablation of the prolapsed mass may be reserved or the retracted rectum may be fixed by suture to the anterior abdominal wall.

Longitudinal Cauterization.—The patient having been anæsthetized and placed in the lithotomy position, the thermo-cautery should be drawn slowly along the surface of the prolapsed mass from apex to base, so as to produce a linear eschar throughout the whole length of the mass. As the sphincter is neared the eschar should be made deeper. The number of stripes may vary from three to six or more according to the size of the prolapse. Care should be taken to choose portions of the mucous membrane that are free from manifest venous dilatations. After the cauterization has been effected the parts should be lightly dusted with iodoform, and gently reduced within the sphincter. The patient should be confined to bed until the wounds are entirely healed. The bowel after the second day should be moved by a saline laxative, and softness of the stools obtained for an indefinite time thereafter. For some time precaution should be taken to permit the bowels to move only when the patient is recumbent. This method has the special approval of Van Buren, Allingham, and Kelsey.

Cuneiform proctoplasty is effected by making an incision in the median line of the perineum from the coccyx to the margin of the anus: into this the finger is inserted, and by it the posterior cellular connections of the rectum are broken up. A knife is then introduced into the dilated anus at a point from one-half to one and a half inches to one side of the median line—the greater the relaxation of the orifice the farther away from the median line the place of incision—and from this point a deep incision is carried, dividing all the tissues backward to the coccyx, including the sphincter muscle, the skin, and the subcutaneous cellular tissue. The knife is then reintroduced into the anus a like distance to the other side of the median line, and a similar incision carried backward to the coccyx. Continuing upward from this cut, a long triangular piece should further be cut out of the posterior wall of the rectum, embracing the whole thickness, which in the first step of the operation had been separated from its pelvic connections. After hæmostasis has been secured the incision in the rectal wall is sutured, preferably with fine silk sutures, beginning above and working down through the anal margin, the knots being tied on the mucous surface of the bowel. The ends of the divided

sphincter are next carefully sutured in apposition. Finally, the ano-coccygeal incision is brought together with deeply-placed silkworm-gut sutures, except near the coccyx, where space is left for the insertion of a small mesh of iodoform gauze as a drain. A suppository of iodoform and opium should be placed in the rectum. Great care should have been taken to have the bowels thoroughly empty at the time of the operation, and they should not be permitted to move thereafter until the fifth day, when they should be moved by carefully administered enemata of sweet oil and of warm water. Some suppuration may take place and a temporary small fecal fistula may occur, but ultimate sound healing with cure of the prolapse has been secured in the cases that have been reported by Roberts, Bell, and Kammerer.

Ventro-fixation of the Rectum.—Mr. Herbert Allingham in 1888 suggested that prolapse might be due in some cases to an abnormally lengthened rectal mesentery, and that in such cases it would be proper to make a small incision through the abdominal wall on the left side, just above the outer third of Poupart's ligament, then introduce the fingers into the abdomen, catch hold of the rectum, pull it up as far as possible, and finally suture its mesentery to the abdominal wall, so as to cause it to become adherent and prevent any subsequent intussusception. In 1894, Mr. Caddy of Calcutta put this suggestion into effect in the case of a much-weakened man who was suffering from a complete prolapse of the rectum six inches in length. An uncomplicated recovery from the operation and a complete cure from the prolapse was secured. The case was reported in the *Annals of Surgery* for February, 1895.

Amputation of the prolapsed mass, when attended by full precautions for asepsis and hæmostasis, may be effected with but little risk of untoward results. The peritoneal sac will be more or less widely opened, and as much of it may be unhesitatingly excised as may be involved in the prolapse, after which the opening in it should at once be carefully closed by suture. The technique of the operation is very similar to that of the removal of the lower segment of the rectum for piles. The incision should first be made at the muco-cutaneous junction, and should be deepened between the sphincter and the mucous membrane until the submucous tissue is freely opened up: by tearing with the fingers and snipping with scissors the prolapsed mucosa may be quickly separated as far down as to the apex of the mass, forming now a projecting cuff, which serves as a convenient mass wherewith to make subsequent traction and to expedite the further steps of the operation. The prolapse is now cut across at the level of the anus, dividing the anterior wall first, and opening the peritoneal cavity. After the suture of the peritoneal wound the rest of the prolapse is rapidly severed, all bleeding vessels are compressed at once, as they are cut, by pressure-forceps, which seize the entire thickness of the cut end of the bowel and secure it from retraction. After the amputation has been completed the bowel-stump is next attached to the margin of the anus by many silk sutures, which involve the whole thickness of the wall of the rectum. As the forceps are in turn removed in preparation for the suture, any bleeding point made evident is ligated.

This method is so simple in its execution and final in its results that it may be resorted to not only as a *dernier ressort*, but also as a substi-

tute for other methods. It induces but little pain, leaves a simple external wound, and involves no protracted after-treatment. The risks of serious peritoneal infection will, however, always require especial care to guard against them.

PERIANAL WARTS—CONDYLOMATA.—The conditions of warmth and moisture presented by the perineal region favor the development of cutaneous warty growths, especially when the skin is habitually irritated by contact with acrid secretions. They may attain very considerable dimensions, springing from narrow pedicles and branching out into cauliflower-like masses at their summits. When covered by folds of the buttocks the secretion exuded from the follicles, by retention and decomposition, may become fetid and irritating, and excite more or less irritation and pruritus of the surrounding skin.

These warts are neither syphilitic nor gonorrhœal in their nature, although they may be caused by the irritation of a gonorrhœal discharge or the secretion from the syphilitic lesion, as from any other irritant. It is important not to confound them with the raised mucous patch of secondary syphilis. The syphilide presents a diffused infiltration and hypertrophy of the superficial layer of the skin, forming a broad, flat elevated mass, without the tendency to pedunculization and cauliflower-like structure of the non-specific warts. The two may coexist. Epithelioma at the verge of the anus will present at its early stage a more or less warty surface, but these nodules are superimposed upon a base of deep infiltration, which when noted will declare at once the real nature of the growth.

Treatment.—Desiccation, followed by ultimate disappearance of perianal warts, may be secured by scrupulous attention to the cleanliness of the part and by frequent dusting into the crevices of the warty growth such astringent powders as tannin or subsulphate of iron. Crystals of chromic acid are even more effectual, adding a moderate escharotic effect and being equally painless. The use of the more active escharotics, such as nitric acid or potassa cum calce, is undesirable on account of the difficulty of limiting their effects. If these remedies fail, the warts may be gotten rid of by excising them with scissors and touching each bleeding point with the thermo-cautery: this method may be used at first, without resorting to the other remedies mentioned. If the growths obstinately recur, a more extensive excision of the skin from which they spring may be made.

ECZEMA OF THE ANUS.—A chronic eczematous condition is often developed in the skin about the anus from the irritation of moist acid discharges flowing over it and the persistence of congestive conditions provoked by hemorrhoids or other lesions of the region. The affection may be limited to a superficial dermatitis of but little extent, or may involve a wide area of the perineum and buttocks, presenting the changes of chronic eczema in an aggravated form. Every intervening degree may be encountered.

A not infrequent cause is the presence of oxyurides in the rectum. When these pests descend to the anal margin they produce by their wrigglings a most annoying itching, and the scratching and rubbing which follow bring about a dermatitis.

The itching which attends every degree of this affection is extremely

annoying, and is sometimes intolerable. It is marked by exacerbations and remissions, but is generally worse at night. The tendency to scratch and rub the part is irresistible, and still further aggravates the difficulty.

The treatment should begin by the removal of the cause when discoverable. Worms must be eradicated, piles must be removed, ulcers healed. The more acute inflammatory conditions may be relieved by hot fomentations of lead-and-opium solutions; acrid discharges may be neutralized by a lotion containing carbonate of soda; chronic inflammatory thickening of the skin requires friction with green soap, supplemented by bland antiseptic ointments; the lesser degrees of induration yield readily to twice-daily applications of lotio nigra (hydrg. chlorid. mitis ʒj, aquæ calcis Oj) well sopped upon the parts for from ten to fifteen minutes. The wash should be allowed to dry, after which the parts should be kept covered with zinc-oxide ointment until the time for the next application of the mercurial. In cases that do not yield readily to these remedies benefit may be expected from ointments of resorcin or of ichthyol. Each of these may be used in a strength of 10 per cent. of the drug at first, the strength to be increased, if necessary, according to the effect secured.

Pruritus.—The intolerable itching may require special applications for its relief in addition to the general treatment of the eczema. Occasionally the pruritus seems to be a distinct neurosis, examination revealing no adequate cause for it; in other instances an atrophic condition of the skin at the anal verge, usually a senile change, will be the only apparent lesion. For the relief of itching as a distinct symptom chloroform ointment (12 per cent. strength) is especially praised. A hot solution of bicarbonate or biborate of soda is often efficient. Oil of peppermint added to the soda or borax solution in the proportion of five drops to the pint increases its antipruritic effect. In the atrophic cases the entire surface may be pencilled over with a mixture containing equal parts of carbolic acid and tincture of iodine, with much benefit.

Congenital Malformations.—Rectal malformations due to arrested or imperfect development, though rare relatively to the entire number of children born, still occur frequently enough to bring them at some time under the observation of most practitioners of much and long experience. The mortuary statistics of the city of Brooklyn for a period of five years from 1891 to 1895, inclusive, show that during that time 25 children died in that city within a few days after birth from complete congenital imperforation of the rectum or anus. During this same period there were 90,180 births recorded, but it is the opinion of the Registrar of Vital Statistics of that city that not more than one-half of the actual births are recorded. Accepting his estimate as correct, if there were 180,000 children born, the proportion of cases of imperforation of the rectum or anus was 1 to every 7200 births.

The malformation may be of any degree, from simple undue narrowness of the lower portion of the rectum or partial closure by a bridle-like valvular projection into its lumen, or incomplete bridge of tissue occluding its outlet, to complete absence both of the rectum and of the colon. While there is no limit to the possible varieties and no two cases

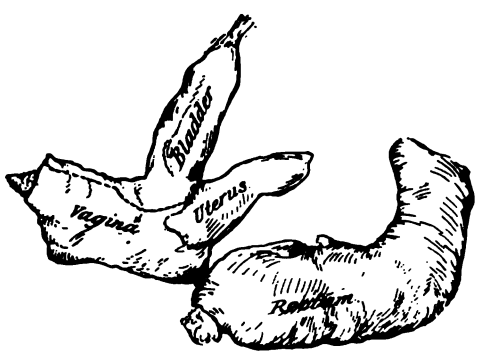
will be exactly alike, for purposes of discussion they may be grouped under the following general classes:

(1) The rectum is pervious throughout, but is more or less narrowed, either by uniform contraction of its calibre along some part of its course or by incomplete bridles of mucous membrane or skin.

(2) The rectum is pervious, but opens on the surface at an unnatural point, usually into some portion of the genito-urinary tract.

(3) The rectum terminates in a cul-de-sac or is absent altogether. The thickness of tissue which intervenes between the surface of the perineum and the closed pouch of the rectum may vary from that of a thin membranous diaphragm to some inches of connective tissue. The anal apparatus may be present, leading into a shallow pouch, or the perineal raphe may extend as an unbroken line from the scrotum to the coccyx. The accompanying diagram (Fig. 299) shows the pelvic viscera in a case of this class which was under my personal observation.

FIG. 299.



Sketch showing absence of lower third of rectum. The bowel terminates in a cul-de-sac at the level of the utero-rectal reflection of the peritoneum; in the lower end of rectum there is an opening made by operation, through which a bit of cotton protrudes (from specimen in the Museum of the Methodist Episcopal Hospital).

Other abnormalities, such as the termination of the ureters into the rectum or the opening of the uterine or vaginal canal into it, have been noted. Their discussion belongs, however, more properly to that of genito-urinary abnormalities.

In the first class of cases the symptoms provoked will depend upon the amount of obstruction to the passage of fecal matter that the stenosis produces. As long as the fæces are soft or the natural narrowing is unaccompanied by inflammatory induration or swelling the existence of any defect may pass entirely unnoticed. When obstructive symptoms arise and examination of the rectum is made to discover its cause, the existence of the defect becomes apparent.

The **treatment** required does not differ from that applicable to acquired stenosis. Gradual and methodical dilatation is more apt to be beneficial than in the latter class of cases. In the case of infants the mother's finger will make the best of dilating instruments.

In the second class of cases the unnatural opening of the rectum is found in some instances upon the open cutaneous surface, and in other instances along the mucous surfaces of the genito-urinary tract. The

symphysis pubis, the preputial fold, the root of the penis, various points in the perineum, the gluteal region, the sacral region, and the loin, have each been the site of abnormal cutaneous opening of the rectum. In the majority of recorded cases the termination of the intestine has been by a long and narrow canal or aperture, too small for its easy function as a fecal outlet. In these cases some plastic procedure to secure a greater amplitude to the outlet, and, if possible, its transfer to its normal situation, is indicated. By means of a suitable sound the course of the rectum can be determined, and the direction and the extent of the operative incisions guided. After the new opening has been established the abnormal tract should be dissected out. In some instances mere dilatation of the abnormal outlet may be all that the case requires.

Opening of the rectum into the genito-urinary canal is one of the more frequently occurring varieties of rectal malformation. When the opening is into the bladder or urethra the communication is usually by a narrow canal with a minute orifice through which only liquid fecal matter can escape. A similar narrow pipe-like opening may be present when the communication is with the vagina, but numbers of instances have been recorded where a sufficiently large intravaginal orifice has existed for all the requirements of defecation, and where women have married and borne children without inconvenience from the malformation.

The opening of the rectum into the bladder will be indicated by the fact that escape of meconium occurs during urination only, and that the fecal matter is intimately mixed with the urine. The rectal pouch in such a case lies so high up in the pelvis that it probably cannot be reached with safety through a perineal incision. The proper procedure is to at once bring the colon out in the left inguinal region, divide it completely, invert and suture the opening of the lower segment, and return it to the abdominal cavity, after which the end of the upper segment should be sutured into the inguinal wound and a permanent inguinal anus be established.

A recto-urethral communication declares itself by the oozing of meconium more or less in the intervals between urination, and by the fact that when urine is passed, although the first that is evacuated is stained, it afterward becomes quite clear. A deeper descent of the rectum toward the perineum is probable in these cases, and an attempt to reach the rectal pouch by dissection from the perineum should first be made.

In cases of vaginal anus, if the aperture is minute, treatment similar to that mentioned for urethral anus will be indicated. When, however, the opening suffices for satisfactory defecation, operative treatment should be deferred until after puberty, after which time the greater room in the pelvis and the increased amount of tissue will make a plastic operation more likely to succeed. An attempt should now be made to transplant the anal orifice to the perineum by dividing the perineum and vagina from the coccyx to the margin of the anal opening by an incision which exposes, but does not open into, the rectum. The lower end of the rectum should then be carefully enucleated, together with the anal orifice, and the whole mass carried backward and downward until the orifice can be sutured in the natural position in the perineum. Suitable suturing of the perineal and vaginal wounds completes the operation.

The third class, in which the rectum ends in a cul-de-sac, constitutes the variety which in its various forms is most frequently encountered. Absolute absence of fecal discharges from the time of birth, followed after a few days by vomiting and meteorism, are the symptoms which it provokes and which lead to an examination of the anal region. Simple inspection reveals the nature of the case when no anal depression exists: in other cases the introduction of a finger or a sound into the anal opening demonstrates the absence of the usual canal. Should a fluctuating, bulging tumor be seen or felt, the existence of a thin diaphragm occluding the outlet is indicated, and a free crucial incision, followed by snipping away of the angles, will suffice for its relief. Subsequent occasional introduction of the mother's finger should be practised to prevent cicatricial contraction. When no frankly-evident bulging tumor can be felt the depth from the surface of the rectal pouch must remain uncertain, and it must be sought for by systematic and careful dissection. The thrusting in of a trocar for exploring purposes should never be done, on account of the danger of intraperitoneal fecal extravasation from wounds made by it. When there is evident defective development of other pelvic structures the probability of the termination of the rectum being high up is so great that it is better to make no attempt to reach it from the perineum, but to proceed at once to make an inguinal colostomy.

To make the perineal exploration, which should be done as soon as the nature of the case is discovered, the child, having been chloroformed, is placed in the exaggerated lithotomy position and an incision carried in the median line from the root of the scrotum or the vaginal fourchette backward to the coccyx. Being careful to avoid the urethra or vagina, the incision is carried systematically upward and backward. By the use of retractors and hæmostatic forceps the incision may be so managed that the character of the tissues exposed at each step of the dissection may be recognized as it is deepened. If the rectum is not met with after reaching a depth of an inch from the surface, the incision should be prolonged backward from the coccyx, and that bone should be cut away, after which the dissection may be carried upward, following the curve of the sacrum, for another inch or inch and a half. If the intestine is recognized before it is opened, it should be enucleated as much as possible from its connections, so as to allow of its being brought down to the surface of the skin. If, however, it is opened into before this is done, no attempt of the kind should be made, for the wound is at once flooded with meconium. The peritoneum, not infrequently, is prolonged over the lower end of the rectal pouch when it is high up, and with every care may still be wounded: the danger of such a wound should negative at once further deepening of a wound filled with fecal matter. The incision in the bowel for the same reason should be lengthened upward along its posterior wall sufficiently to ensure a free aperture for the escape of the rectal contents.

The **after-treatment** of the case should be very simple. Unless the intestine has been enucleated and brought down to the skin-level, no suturing should be done; between the wound-surfaces should be placed a fold of lint smeared with zinc or boric ointment to prevent adhesions; frequent irrigations for the purpose of cleanliness should be made. As cicatrization advances undue contraction of the aperture must be pre-

vented by systematic finger or bougie dilatation. If the tendency to contraction is subsequently found to be so great as not to be readily overcome, an inguinal colostomy should be done.

When the perineal exploration fails to discover the end of the rectum, left inguinal colostomy should at once be done.

THE SURGERY OF THE LIVER AND BILIARY PASSAGES.

By ROBERT ABBE, M. D.

THE surgery of the liver, gall-bladder, and bile-ducts now occupies a prominent place in medical literature, and can lay claim to a degree of importance quite on a par with other fields of surgery in which great advances have been made. It offers to the patient a degree of security from the mishaps incident to neglected or misunderstood diseases as seen in earlier days, and makes this field take rank with the other divisions of abdominal and pelvic work—those of ovarian and tubal diseases, appendicitis, and intestinal operations.

To appreciate the details of procedures that are now most common a brief consideration of the anatomical points involved in the upper right section of the abdomen will aid our understanding.

Anatomical Relations.—For practical purposes the liver may be considered as hiding entirely under the right lower ribs, its lower border corresponding to the free edge of the chest-wall, while in front it crosses the epigastrium to the left side. It lies in contact with the abdominal wall for a space below the sternum halfway to the umbilicus.

It is often important to determine whether the liver is sensibly enlarged, and one must keep in mind the limits of dulness on percussion, which are modified above by the overlapping edge of lung and below by the underlying stomach and intestine. In the normal state the upper margin of positive dulness should be, in the median line, at the base of the xiphoid cartilage; in the nipple line, at the right sixth rib; in the mid-axillary line, the eighth rib; and behind, where it is usually capable of clear definition, the tenth rib. Its lower border is found in the mid-epigastrium, halfway between the base of the xiphoid cartilage and the umbilicus; in the nipple line, at the free border of the ribs; in the axillary, between the tenth and eleventh ribs; and farther back it is lost in the dulness of the muscles.

In women the liver lies sensibly lower, especially where lacing has been indulged in. In the upright position also the liver descends, and can be discovered just below the costal border. A long needle introduced at right angles to the chest-wall at the right sixth intercostal space will strike the top of the liver at some distance within.

The support of the liver in walking depends on its posterior or coronary ligament and its superior or suspensory ligament. The liver abuts against the posterior chest-wall by a wide and deep portion of its base uncovered by peritoneum—a portion that plays a rôle in some surgical

work wherein the approach to deep abscesses can be had without traversing the peritoneal cavity.

The peritoneum is reflected from the diaphragm to the convexity of the liver above, and leaves the base of the liver below to invest the duodenum, kidney, vena cava, and gall-ducts, becoming laterally the covering of the abdominal wall and anteriorly continuous with the mesentery of the ascending and transverse colon. Toward the median line it invests the stomach. Between these it is continuous with the foramen of Winslow, opening into the lesser peritoneal cavity.

The gall-bladder, which in health should contain one ounce, lies on the under side of the liver about its middle, with its base forward and in contact with the cartilage of the ninth rib. It cannot be felt in health even in palpating very thin subjects, but when enlarged it can be detected either by palpation or percussion.

The small intestines are under all circumstances shut off from the portion of the peritoneal cavity contained between the liver and the colon. The latter lies in contact with the abdominal wall throughout its course from the caput coli to the splenic flexure, and its mesentery therefore forms a partition, as it were, bounding a subhepatic space in which we find ourselves confined in operating on the biliary passages.

If we observe the post-mortem staining by the gall-bladder on adjacent parts, we see that it habitually lies in contact with the hepatic flexure of the colon, stains by its base the abdominal wall, and by its deeper part the pyloric end of the stomach and the duodenal investment. An extravasation of bile, therefore, would have to overreach the colon or descend beside the caput coli to the right iliac fossa before entering among the smaller intestines. This anatomical impression of the gall-bladder upon neighboring parts is of importance in explanation of various pathological conditions and in the technical applications of surgery.

The peritoneum, leaving the under surface of the liver, descends upon the back wall of the abdomen, covering the anterior face of the kidney, duodenum, and vena cava.

From the under surface of the liver the gall-bladder can be readily stripped by blunt dissection after the scissors have snipped its peritoneal attachment which holds it thereto. The gall-bladder ends at the cystic duct, which makes a sharp double flexion, enters the fold of gastro-hepatic omentum, joins the hepatic duct, becomes the common bile-duct, which descends in front of the portal vein and behind the duodenum to its middle, where it joins the pancreatic duct, and with it pours the mingled secretions into the intestine through a minute orifice called the papilla, which is about four and a half inches from the pyloric orifice. Passing the finger over the mucous membrane within the bowel, this cord-like channel can be felt descending behind it, the opening being much nearer the lesser curve of the duodenum.

The lower part of the common duct can be reached from in front by a vertical cut through the peritoneum covering the outer side of the duodenum, through which the finger can be passed behind the latter to raise it with the head of the pancreas from the posterior wall and draw it toward the median line. The upper portion, where the cystic duct joins it, can be reached by incision and blunt dissection nearer the liver, pressing the first portion of the duodenum downward.

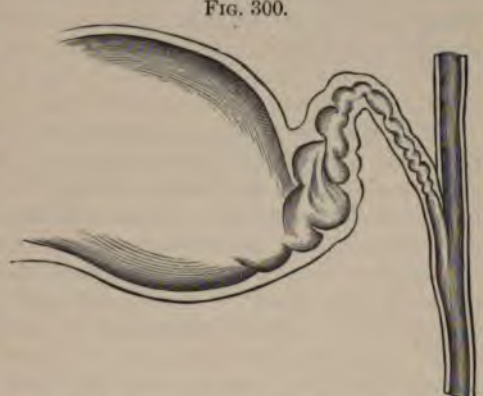
The gall-bladder is normally four inches long, and at its anterior end an inch and a half in diameter. The cystic duct is one inch long, and the common duct three inches, so that roughly we can estimate the distance from the neck of the gall-bladder to the papilla as a finger's length.

The passage of a probe from the gall-bladder to the intestine in a duct not previously distended by discharge of gall-stones is almost impossible, owing to the valve-like convolutions of the lining membrane of the cystic duct which entrap the probe at every point. In only about one in four cadavers, as shown by Terrier and Dally in their admirable study of possible catheterization of this canal, including such as may have been stretched in life, is it possible to pass a probe. It is even more difficult in the living subject, where muscular spasm is added. When, however, pathological changes have occurred the dilatation is often great, and in chronic cases of impaction of stone in the common duct one can pass his finger frequently through the dilated cystic duct upward into the liver or downward into the common duct.

The cystic duct is the smallest part of the biliary channel. Hence small stones that succeed in traversing that, usually make a quick transit through the common duct.

The contour and duplicatured folds of the neck of the gall-bladder, as well as the acute angle of junction of the ducts, are well shown in the accompanying cut (Fig. 300); which one can best demonstrate for himself by distending the parts with alcohol and hardening in alcohol for a fortnight before making a section. All the inner parts retain thereby their normal appearance.

FIG. 300.



Illustrating anatomy of gall-bladder: section of normal duct (from article by the author (Robert Abbe) published by *N. Y. Med. Record*, May 6, 1893).

Just at the angle of the cystic duct there are normally two small lymphatics, insignificant in health, but which I have found in inflamed conditions sufficiently enlarged to produce of themselves pressure enough to cause obstruction. These may exert some influence in prolonging cholæmia in ordinary catarrhal inflammation.

The hepatic, cystic, and common ducts all lie in front of, and directly upon, the great portal vein. Near its junction with the pancreatic duct the common duct lies upon the vena cava, hence much caution is needed in incising the walls of these ducts not to cut through them.

It will be seen that in the neighborhood of the neck of the gall-bladder the duodenum occupies the floor of the subhepatic space, and the pyloric end of the stomach usually intrudes itself on the median side, so that if inflammatory adhesions are formed the latter is very apt to be bound to the parts.

Turning to the external relations of the liver, we are reminded that in puncturing the chest-wall over it we shall traverse the thin lower

part of the pleural cavity if we are guided only by the upper area of liver dulness. The safe limits are defined anatomically. The lower limit of the pleural sac is at the front just behind the seventh costal cartilage. In the right axillary line it comes no lower than the ninth rib, while at the back it lines the twelfth, and even descends as low as the transverse process of the first lumbar vertebra. If, therefore, one resects the tenth rib in the axillary line, one finds cellular tissue and diaphragm, but no pleura beneath it. But having traversed the diaphragm, one then enters the free peritoneal cavity and meets the liver. It is obvious that extravasation of pus from a liver-abscess at this point, if the parts be not sealed by adhesions, will foul the peritoneal cavity.

Palpation.—The exposed epigastric (triangular) portion of the liver is the only portion capable of direct palpation in health. Yet through the abdominal walls, especially in women, the movement of the edge on deep inspiration can be often perceived. If the organ can be distinctly felt making to-and-fro excursions with inspiration and expiration, one can feel sure that it has been displaced or has suffered gross enlargement. Such general tumefaction may be found in states of chronic engorgement from obstruction, from hyperplasia, from syphilis, pyæmia, or occasionally in leucocythæmia.

One may feel by palpation, on the other hand, a local enlargement—tumefaction of the right lobe only, or a globular swelling near the free border at the site of the gall-bladder, or in the epigastrium, or even, though rarely, in the left lobe. Such special tumefactions are felt in simple gall-bladder distention, in empyema of the gall-bladder, in abscess of the parenchyma, in hydatid cyst, cancer, actinomycosis, or syphilitic gumma.

Palpation of a simple distention of the gall-bladder is not always easy. If a hardness is felt at its site, it is more often a compound mass, the sequel of local peritonitis, usually including the flexure of the colon, with perhaps omentum drawn up, adherent to the stomach-wall, the duodenum, and gall-bladder.

There are tumors occupying the subhepatic space that must be differentiated from those of the liver itself. They are cancerous masses of the pylorus or walls of the stomach; solid or cystic tumors of the pancreas; renal tumors which grow forward in contact with the under surface of the liver; or cancer of the colon itself.

In renal tumors the colon resonance normal to the lumbar region is always absent, because the colon is pushed forward by the enlarging kidney. Pancreatic tumors are mostly centrally placed, and do not move with respiration. Stomach and pyloric cancer have associated functional disturbances by which they can be clearly diagnosed, or, like colon cancer, usually display greater mobility on handling than do any liver tumors. All hepatic tumors show dulness on percussion continuous with the liver.

I have heard physicians say they "could feel a gall-stone through the abdominal wall," but such perception would be, I conceive, a physical impossibility. One is not able, as I have frequently had opportunity to prove, to say whether a gall-bladder containing bile has or has not a stone in it when one is handling that viscus itself through the open abdomen.

Surgical View of Jaundice.

The presence of jaundice in any patient should always lead the practitioner to consider what are the possibilities of surgical complication. In a word, What is its surgical import? One is surprised to find in the history of many patients with the gravest hepatic diseases how many have no jaundice or have only a mild show of icterus late in the trouble. It cannot be classed as pathognomonic of, or constant in, any but the gravest obstructions of the common duct. These are chronic gall-stone obstruction, cancer, and suppurative cholangeitis. On the other hand, it is the most uniform accompaniment of simple cartarrhal duodenitis extending into the ducts.

The gravest hepatic diseases coming under the surgeon's care, excepting those mentioned, may be entirely free from jaundice, especially in the early stages. Such we find to be the case in hydatids, cancer, abscess, gumma, cholelithiasis, empyema of the gall-bladder, and even in portal phlebitis. Hence we often see very slight icterus discounted by the physician as not a subject for anxiety, while, as a matter of fact, any of the above conditions may have made great progress while he has been waiting for more pronounced symptoms. Too much emphasis cannot be laid therefore upon the very slight phases of jaundice in cases of invalidism, as it is by the early recognition of such graver troubles, as we shall see later, that surgery may opportunely step in to save life. The physician must keep in mind that almost total arrest of the outflowing bile at the common duct or through one of the main branches of the hepatic is necessary to produce jaundice.

The presence of grave chronic cholæmia has been regarded by some as a contraindication to operation, or at least as a desperate complication. It has been held that capillary hemorrhage is very apt to occur as a dangerous sequel. While its presence is undoubtedly the cause of some blood-changes that may act as irritant enough to set up nephritis, so that casts and albumin are often found in the urine of such cases, it is notably true that as soon as the outlet of bile is established the blood quickly clears itself and albumin and casts disappear. A precipitate by nitric acid, which resembles albumin, but is dissolved by alcohol, is often seen in cholæmia.

In some of the cases I have operated upon, where chronic jaundice of the deepest dye had existed for two or three years, there was no tendency to hemorrhage. On more than one such occasion the blood in the operative field had a slippery or soapy feeling on the fingers from saturation with bile-salts.

There has been observed in this class of operations a persistent post-operative oozing from the capillary vessels of the velvety lining of the gall-bladder, due to release from pressure in distention cases. This has been known to be very grave and resist even the control of packing. Such persistence should be regarded with anxiety, and styptics combined with greater pressure used.

Field of Operation.—Various operators prefer certain lines of incision, which have in their own hands served them best, in reaching the liver.

Where a prominent tumefaction is present the general rule of surgery

will prevail, to incise vertically over the most prominent portion. Where there is no prominence, and one expects to work in the deep subhepatic space, one must have the most room he can get with the least incision. It often happens that one desires to make a small exploratory opening wherein to introduce the index finger, and may afterward choose another site. For such small cut the best available spot is just below the tip of the tenth rib on the outer border of the rectus muscle. Here a vertical cut has only to divide skin, fascia, and peritoneum. If more room be needed, this must be prolonged downward on the outer side of the rectus, a hand's breadth from the median line, to a distance of four inches, and then, if desirable, join the lower end by a cut across the rectus, or nearly so, to the median line. I have had abundant experience with this, and believe it gives most ample space for all work in this field.

Others prefer an oblique incision parallel to the edge of the ribs and a half inch from it. This is ample for many gall-bladder cases, but is not as capable of extension as the vertical; yet it gives a roomy approach to the deep subhepatic space.

It is of less importance to have a small scar in the upper part of the abdomen than in the lower, in view of the frequent occurrence of hernia in the scar of the latter position.

Scars of the upper portion are not prone to hernial protrusion, owing to the mechanical action of the viscera, which all gravitate to the lower part. Hence we should not handicap our work in this field by too small an exhibition of the parts, which at best are not easy of approach.

As regards the cross-incision of the rectus, I do not hesitate to say that when two or three buried sutures have held it in contact for a few days union becomes much more resisting to later separation than ever takes place between the edges of a muscle split lengthwise or in a cut parallel to its outer edge.

A vertical median epigastric incision joined by a cross-cut at the level of the navel has been advocated (Czerny), but has the disadvantage of encountering the round ligament of the liver descending to the navel, which sometimes has an open vein in it, and does not seem to me to give as direct approach to the gall-ducts as the incision outside the rectus.

Wounds and Injuries of the Liver and Gall-Bladder.

The proximity of the liver to the abdominal and chest wall, in spite of its protected position, makes it subject to many mishaps of a grave nature from such common injuries as kicks, falling beams, catching between buffers in coupling cars, impact in falling from scaffoldings, fractured ribs, etc., which result in subcutaneous lacerations of the liver or rupture of the gall-bladder. Stab and gunshot wounds claim a considerable share of attention, inasmuch as, including the grave lacerations, they show a mortality, according to Edler, of from 55 to 85 per cent.

The slighter degrees of laceration of the parenchyma and capsule of the liver are undoubtedly relatively common. This organ may be considered, at best, rather a friable viscus, and when merely split a little upon its surface a slight hemorrhage and a trifle of bile extravasated are quickly absorbed after a limited reparative peritonitis. When the rent goes deeper and larger blood-channels are torn, hemorrhage is usually

severe, because the walls of the veins are held open by the liver-structure. If the gall-bladder is ruptured, many ounces of bile are poured out and more serious disturbances follow.

As to the **diagnosis** of rupture, Bryant says, after recently quoting five cases, "It must be confessed there are no special symptoms which can be accepted as indicative of its existence, although severe shock and collapse as immediate result of a forcible injury to the right side of the thorax should always suggest its probable existence, and even when the same kind of injury to the same region is unattended by any such serious symptoms, the surgeon should be alive to the possibility of a limited rupture of the liver being present, and treat the case accordingly."

The grave **symptoms** are doubtless due at first to the loss of blood, which sometimes continues for hours, as shown by Dalton's case, still bleeding five hours after a stab wound. The peritoneal irritation by bile is also a factor. It can now be definitely said, however, that while bile is an excitant of plastic inflammation tending to repair, it does not act as a fatal poison nor produce septic peritonitis, except where suppurative processes have pre-existed in the gall-bladder. Even when extravasated in large quantity nature has been known to take care of it unaided in a few cases. In a case of Bryant's a fissure in the liver two inches by one inch was found at the autopsy on the eighteenth day to be filled with organizing clot and lymph, while the empty gall-bladder showed a rent three-quarters of an inch long, also sealed with lymph. Arbuthnot Lane reports the case of a boy struck in the epigastrium by a wagon-pole who recovered from great shock with a distended stomach. He improved so much as to walk about in a week, and was well enough to be discharged at the end of a month. A recurrence of distention with depression occurred, and on laparotomy three gallons of bile-stained fluid was released. A later operation showed that a laceration of the gall-bladder had probably occurred. The boy recovered. Other equally striking cases are on record. Michaux reported a successful removal of ten ounces of bile from the abdomen seventeen days after a rupture of the gall-bladder.

The comparative innocuousness of healthy bile in the peritoneal cavity is shown by the fact that bile-staining in animal experiments and the smearing of bile on neighboring viscera in many gall-stone operations occur without harm following.

The results of operation for stab wounds of the liver encourage one to take this step in every case. Large intra-abdominal clots mixed with bile can be sponged out and hemorrhage controlled. As shown by Dalton, in three out of four cases recovery followed after clean sponging and drainage without irrigation.

Bleeding from a stab wound could be checked by a purse-string suture of large iron-dyed sterile silk.

It should be a rule to operate promptly in every case of punctured or gunshot wound. In fact, in view of the great mortality of rupture of the liver if the presence of profound shock can be a guide to the internal injury, it is justified or demanded to make a digital exploration through a small opening with local anæsthesia made by cocaine or the ethyl-chloride spray, to ascertain the presence of free bile or blood, and to continue the operation under ether if needed. Such a small cocaine

examination I have practised in a stab wound of the belly with great satisfaction. The viscera have no pain-sense, and can thus be handled while the patient is conscious very early after an injury.

Interesting cases of embolism of hepatic tissue into the pulmonary artery, the heart, and lungs have been reported by Marshall, Smorl, and Zenker as following rupture of the liver; also fat-embolism following rupture of a fatty liver.

It may be said that the expectant treatment of lacerated wounds of the liver and gall-bladder is free from risk only in the mildest cases, and that a skilful and careful abdominal section gives the patient a better chance under any circumstances.

Floating Liver.

Numerous cases of this unusual tumor of the abdomen are on record, verified either by autopsy or operation. They occur mostly in multiparous women with lax tissues, and as a rule cause little disturbance. Richelot lately operated upon such a case in a woman of twenty-eight years who was disabled by a painful movable tumor in the right iliac fossa, suspected to be a mass in the caput coli. It was pushed up to its normal site and secured by catgut to the abdominal wall. Parts of displaced liver have thus been anchored by Billroth, Tscherring, and others.

Tumors of the Liver.

There are some tumors other than cancer that will interest the surgeon. Von Bergmann successfully removed an adenoma from the under surface of the liver connected by a thick pedicle. Free bleeding required the use of ligatures and packings. Bardeleben removed a sarcoma of the liver, and had no recurrence two years later. König removed by circular incision and suture a tumor from the under surface, and Schmidt removed a pedunculated gumma and healed the stump extraperitoneally in the wound.

Keen has found 20 cases recorded of tumors of various kinds removed from the liver.[1] The first was by Langenbeck in 1888. I may add to this record that Dr. Peters removed a portion of the liver at the New York Hospital. The long tongue of liver-tissue was supposed at the time to be a neoplasm, but on examination was reported by Peabody to have been a dependent portion separated probably from the costal margin by too tight lacing. Dr. Keen himself removed a cystic mass of some size from the liver adjacent to the gall-bladder with success.

I have removed a spherical gumma one inch in diameter from near the edge of the liver by including it in a wide V-shaped piece, which I first surrounded by a series of chain stitches of iron-dyed silk. The liver was returned with its large notch unclosed, and gave no unpleasant results.

Cavernous angioma is said to be one of the commonest forms of primary tumor, developing by dilatation of existing capillaries and atrophy of liver-cells. It may grow to be as large as an egg. An excellent

[1] *Boston Medical and Surgical Journal*, 1892.

illustration of this is in the Army Medical Museum. I see no reason why such might not be treated by ignipuncture, as are external nævi.

Keen concludes from his experience and analysis of recorded cases that a considerable part of the liver can be safely removed with tumors. In the cat and rabbit experiment shows that as much as three-quarters of the bulk of this organ can be safely taken away, and not be followed by serious consequence, as shown by Ponfick and Von Meister. The portion remaining hypertrophies and regains function.

If a considerable portion can be removed without injurious effect, how can it be safely done? Hemorrhage and bile-extravasation have been the two bugbears of the surgeon in this field. In 20 recorded cases 18 recovered; 1 died of shock and 1 of sepsis. This promises reasonable security in future work in this field.

The methods of controlling hemorrhage have been by cautery, packing, clamp and ligature, or by suture. The cautery knife will seal all minor veins and arteries, but large branches are held open, and will only be controlled by clamp or suture. Ligatures can be used, but are difficult to apply. In my own case the liver was transfixed by a long needle behind and at the sides of the tumors and a chain stitch made with heavy iron-dyed silk. The liver-tissue left between the cut and the ligature need give no more anxiety than an ovarian pedicle. The peritoneal cavity has been proved by Czerny, long ago, to be capable of digesting large pieces of fresh muscle or any healthy tissue that may be placed, aseptically, free in its cavity.

Keen concludes: (*a*) That experiments on animals and operations on man have shown that tumors of the liver, and even large portions of the organ itself, can be removed without undue disturbance of its functions, and experimental evidence makes it probable that the liver itself may be regenerated and the loss made good.

(*b*) That the escape of bile into the peritoneal cavity is not a usual phenomenon after such an operation; that it may generally be prevented either by searing the raw surface of the liver, by ligation, or by securing the stump in the abdominal wound; and even if the bile so enter the peritoneal cavity, the result is not necessarily fatal.

(*c*) The hemorrhage need not be greatly feared. The vessels may be secured separately or in mass, or cut through by the cautery, or controlled by pressure or by a combination of these means.

(*d*) The resection of tumors or amputation is best done by enucleation, by the cautery, scissors, or knife.

(*e*) The mortality has been 10 per cent.

Cancer of the Liver.

The following varieties of malignant growth confront the surgeon:

1. Primary cancer of the liver, with secondary nodules developed later. This is rare and cannot admit of interference.

2. Primary cancer of the gall-bladder resulting from irritation of long-existing calculi. This form is not very common, but admits of excision and dissection from the under surface of the liver, with fair hope of non-recurrence. An occasional hyperplasia of the entire gall-bladder wall, surrounding a small focus of confined pus or calculus,

takes place, simulating cancer most strikingly. It is of an innocent type, and rapidly melts away after evacuation of its central contents. In one such case I incised a hard mass nearly the size of the closed fist, and the only content was a drachm of pus. It was so malignant in gross appearance that I gave the patient a grave prognosis. In four months it had entirely disappeared after external drainage.

3. Secondary cancers, by far the most common, usually develop from metastasis of cells from a small malignant growth in some part of the intestinal tract or pelvis, most of them being in the intestines, cæcum, colon, bladder, uterus, œsophagus, or stomach. It may develop from a focus in the mammæ or elsewhere.

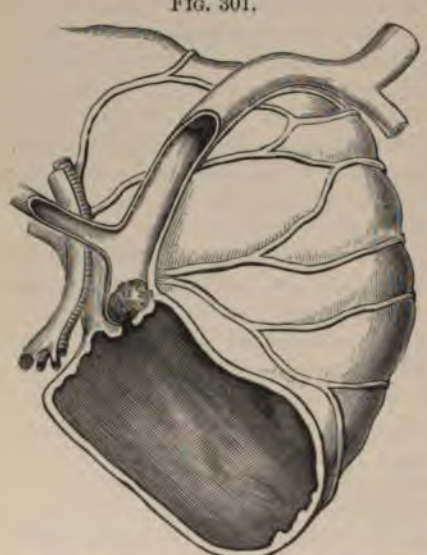
The slow portal current gives easy lodgement for detached cells on the walls of the veins, or plugging by emboli may occur. These growing deposits are always multiple, and some of them sooner or later press on the hepatic-duct branches, thus inducing a tardy jaundice.

The most striking feature of cancer of the liver is its comparative painlessness even when of large size. Ascites and late icterus are not uncommon, and are usually preceded by the cachexia of cancer. Thompson's assertion that 94 cases in 100 have no jaundice may be fairly true of the early symptoms.

The seeds are sown in every part of the liver, hence no surgical relief can be hoped for except that, in the event of early obstruction, a bile-fistula might be justified to prolong the patient's days.

A diagnosis would be based on the age of the patient, movement of the tumor with the liver, cachexia, emaciation, and, later, jaundice, vomiting, and ascites.

FIG. 301.



Carcinoma just within the papilla of the common duct, acting like a ball-valve (author's case).

4. Cancer of the common gall-duct is usually a sequel of pre-existent gall-stone irritation, and the presumption is that ulceration therefrom has provoked the disease. It is undoubtedly more common than is generally thought, and is of interest to the surgeon because it would seem from its anatomy and mechanical action as if it ought to be capable of extirpation when small and when detected in its early stage.

Anatomically, it will be remembered, the ductus communis choledochus descends behind the duodenum, and for a half inch or more transfixes the wall of the bowel obliquely, ending in a contracted and elevated papilla on the mucous coat. It is here that the cancer oftenest develops from the irritated epithelium cells. Its growth may be entirely within the papilla for a while, or it may be extended into the lumen of the bowel, and there grow as a pendulous and finally erod-

ing mass, or it may grow both within and without the duct, but still forming a local mass, with some freedom from deep attachments and capable of dissection.

These three stages are well illustrated in the annexed cuts. The first (Fig. 301) represents a case under my own care wherein the growth was no larger than a small pea, but so placed as to act like a ball-valve and produce an obstructive cholæmia, followed later by a fatal suppurative cholangeitis extending from the bowel into the gall-bladder and hepatic ducts.

The second case (Fig. 302), from Kast and Rumpel's pathological

FIG. 302.

Carcinoma of duodenal papilla; cylindrical epithelioma: woman aged seventy-one; extreme pain without jaundice, December, 1891; stools white, urine dark; skin yellow for months; patient feeling well and appetite good until March; rapid loss of strength. Hospital April, 1892, cachectic, icteric, œdema hands and feet; liver enlarged; main line three inches below edge of rib; organ smooth; edge marked; no gall-bladder tumor; not tender; meteorism and ascites; no splenic enlargement; urine no albumin, no sugar; bile-pigment large. Died in six days, three and a half months after first appeared. *Autopsy.*—Liver handbreadth below rib; no gall-stone; liver and ducts and bladder distended with bile; no metastases.

FIG. 303.

Carcinoma of the duodenal papilla; merchant seventy-four years old, 1870, ill with jaundice and wasting; diagnosed cancer by Skova and Rokitansky; recovered, and was well again. During past five years had attacks of hepatic colic, at first occasional, but increasing until fortnightly. Pain right side; liver swollen on occasions; no gall-stones in stools; symptoms intermit and disappear. May, 1889, acute attack; great swelling of liver; pleurisy. *Autopsy.*—Papillary growth, distending intestinal end of common duct and growing into bowel; no metastases; adeno-carcinoma.

plates, illustrates the local origin of the growth and the simulation of ordinary biliary colic by the obstruction caused by the growth.

The third (Fig. 303) shows a later stage of the same diseased condition, the accompanying history being extremely interesting. The mass was of shaggy growth, papillomatous, and produced its grave symptoms only by obstruction. No metastases were present in any of these cases.

It must be remembered, however, that in this class of small cancer-growths of the duct there may be extensive metastases of both liver and lungs, entirely out of proportion to the original cause. The symptoms of such an obstructive papillary tumor may very strikingly resemble those of gall-stone. The first notice of the trouble may be an acute

colic followed by jaundice, which may be followed later by progressive emaciation, icterus, or cachexia. It is not impossible that the first sharp attack may represent the passage of the irritating calculus. It must not be forgotten, however, that cancerous obstruction of the ducts may have the same history of acute colic and jaundice as accompanies the passage of a gall-stone. I have in mind a gentleman who had suffered numerous grave attacks, each accompanied by transient cholæmia, and who lost much flesh during the year prior to my operating upon him, though recovering perfectly from jaundice between the attacks. Finally, after a three months' respite and apparent return to health, he was seized by violent pain while at the opera, and required a hypodermic injection of morphine before he could return home. On operation some days later, jaundice having set in, I found a small mass of cancer at the head of the pancreas grown round the common duct and as large as a walnut. To ascertain whether this might not be a stone in the duct with surrounding zone of inflamed pancreatic gland, I passed a needle in several directions through it, and found only the resistance that would be felt in tissues as dense as raw potato. The gall-bladder being distended, I explored it without finding calculi, and joined it by anastomosis with the duodenum. The patient made an excellent recovery, and remains well a year and a half later.

It is evident that in such duct-pressure there is an intermittent congestion of the mucous membrane which may give pronounced distention-symptoms and acute colic pain.

It may be said, however, that in general the presence of malignant neoplasms of the ducts is diagnosed by the slow and painless onset of symptoms of obstruction—namely, jaundice, cachexia, and emaciation.

The cachexia of cancer that is seen in this as in other forms of malignant growths is considered as caused by the reabsorption of the products of cell-growth. It is of interest to note that as this disappears after removal of cancer elsewhere, so in cancer of the gall-passages it rapidly gives place to a fresh, clear complexion when the bile-flow has been restored to the intestinal channel by gall-bladder anastomosis with the intestine.

Syphilis of the Liver.

The surgeon must ever keep in mind the multiform evidences of syphilitic infection which he may encounter in any organ of the body. Late manifestations of this disease are seen in the liver in two forms:

First. General infiltration with hyperplasia, so as to make a grossly enlarged organ, either in its entirety, or in one lobe, or a portion of one.

Second. In the form of gummatous tumors more or less hard and varying greatly in size and location. Both these forms may coexist, and an hypertrophied organ may then show multiple gummata also.

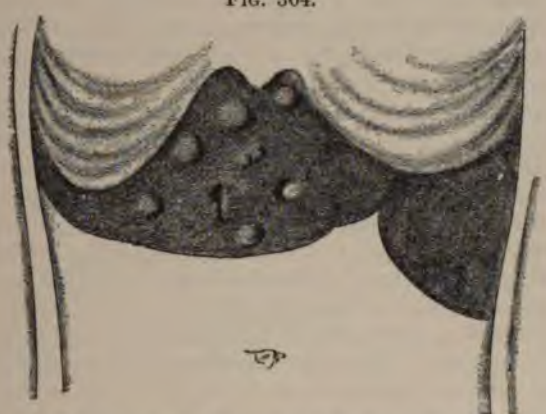
Tumors of the liver of suspicious malignancy, but of atypical appearance, should be subjected to a rigid course of antisyphilitic treatment before decision is reached, and it would not be surprising if surgeons would thereby not infrequently achieve results gratifying to themselves and the patients. This is illustrated by occasional reports of cases. In many a pre-existing history of syphilitic infection is wholly wanting.

Cayley reports the case of a man without a syphilitic history in whom

a prominent epigastric tumor was felt. It was firm, elastic, smooth, round, tender, movable with the liver, and transmitted the underlying aortic pulsation. The patient had also a suspicious gumma over his right shoulder. He was given heroic treatment by iodide of potassium, and in four weeks the gumma and hepatic tumor had disappeared, and the man afterward remained well.

A most striking case illustrating the subject came under my own care two years since. A lady presented herself with enormous hyperplasia of the liver and spleen, as shown in the annexed cut. She had undergone

FIG. 304.



Syphilitic enlargement of the liver and spleen; multiple gummata of the liver; laparotomy and removal of one tumor for examination; cure by subsequent treatment (drawn from life).

removal of enlarged Fallopian tubes for so-called pus-tubes some months previously by a prominent gynecologist. Her convalescence was tedious, a feverish condition lingered, and the enlargement of liver was said to be malignant after exploratory aspiration failed to find pus. When she came to me her afternoon temperature was usually 102° F. She had lost much flesh and was declining rapidly.

Suspecting hepatic abscess, I aspirated in the epigastrium as well as through the intercostal spaces, but failed to obtain pus. Believing still in the presence of a deep abscess, I offered exploratory laparotomy, which she accepted. The liver and spleen were both greatly hypertrophied, and the liver showed on its convexity numerous gray growths partly raised above its surface and resembling cancer-infiltrations so nearly that I should have asserted that they were such, excepting for two or three well-marked crater-like depressions in different spots that made me suspicious of scars of old gummata. I therefore removed one of the tumors, which was an inch in diameter and buried in normal liver-tissue near its edge. To further assure myself that there was not a deep abscess causing the temperature, I thrust a large aspirating needle in many directions to the remote parts of the organ. No trace of pus was discovered.

The patient was given a post-operative course of mercurial inunctions, beginning the evening of operation, and with the happiest results. I had the pleasure of seeing her make a rapid and complete recovery. The fever never returned. The enlarged liver and spleen diminished

from day to day; she gained rapidly in weight and color. In three months the liver and spleen were nearly normal. Mercurial inunctions were alone relied on until her gums were touched, when iodides were added. Dr. Thacher's examination showed the mass to be a pure gumma.

Roberts reports three cases of syphilitic gummata and enlargements of the liver (in one case to enormous size) in all which rapid diminution followed the exhibition of mercury and iodide of potassium. In one the tumor extended downward a tongue-like prolongation from the median portion of the right lobe, reaching nearly to the crest of the ilium, and, as found at operation, of a mottled grayish appearance with a fairly distinct margin defining it from normal liver. It was thought to be malignant, and no removal was attempted, but, a clear history of syphilis being obtained, antisyphilitic treatment was adopted, and in three months the tumor was greatly reduced in size.

The **symptoms** of gummatous tumors of the liver will be not more striking, as far as functional disturbance goes, than if the growth were in another portion of the body.

A local tumor is the first thing, often, to call attention to the trouble. It gives a sense of weight and fulness in the epigastrium, and is usually, when palpated, slightly tender. Jaundice is wanting. Disturbed nutrition will usually be an accompaniment, and a general decline follows. In the case quoted above a low form of fever was an unusual symptom for which no other cause could be assigned, and which rapidly disappeared with treatment. The administration of antisyphilitic remedies is often the only clue to diagnosis, and, as shown by all reported cases, this must be pushed to the extreme endurance of the patient before being abandoned. The liberal use of inunctions two, three, or four times daily at first, and followed by iodide of potassium, fifteen to twenty grains, after eating, and increased as the patient's tolerance allows or the obstinacy of the disease demands, will accomplish a cure.

Actinomycosis.

A few striking cases are recorded of this fatal malady in man, and should be kept in the surgeon's mind when tumors of obscure nature are being considered. The entrance of the ray fungus being through the alimentary tract, the tumor formed by its development is either in the wall of the stomach or intestine, which may seal itself to the liver, or by penetration of the coats and lodgement in the liver, where growth takes place. In either case the disease progresses, as elsewhere, slowly, taking many months to become troublesome. There is an absence of acute symptoms—pain or fever and the appearance of a semi-fluctuating tumor at the edge of the liver or beneath it. It seals itself to the abdominal wall after a time, and when incised discloses only dark granulation-tissue without pus, but with secretion in which the ray fungus may or may not be found. In a case of Eve's many examinations before death showed nothing, but post-mortem search showed typical spores.

The **diagnosis** can be made with some certainty by excluding syphilis, abscess, and hydatids.

Treatment should be on general surgical principles, with the addition of free use of iodide of potassium.

Hydatids.

With the exception of rare cases of multiple small cystic formations and of distended gall-bladder all cysts of the liver are of hydatid origin, and form a most interesting study in the chapter of diseases of parasitic origin to which the body is subject.

The natural history of the parasite should be kept in view to enable us to understand and properly treat the malady. It is to be remembered that the tape-worm, or Tænia solium, infesting the human intestine at times, has as its near relative a different species of smaller size, which infests the intestine of dogs. The ova of the latter when transplanted to the human alimentary canal, probably through the medium of uncooked fruit, vegetables, salads, etc., contaminated by the excreta of dogs, find the requisite conditions for growth, and man becomes the host of this unwelcome worm.

In its new home the capsule becomes dissolved and the embryo penetrates the mucous membrane of the bowel, easily finding its way thence by venous channels of the portal circulation to the liver. There, by virtue of the sluggish current, it fastens itself on a vessel-wall by its hooklets and grows. The embryo has a minute head and mouth armed with a crown of hooklets like microscopic tiger-claws, and from its body is evolved a cyst which in six months develops to the size of a walnut. Within this envelope is developed a fertile crop of new embryos, budding like miliary projections from its lining membrane. Examining these with a low-power microscope, each is seen to be an ecchinococcus head or "scolex," having suckers and hooklets. As one grows all grow, and multiply within the parent, until a cyst of appreciable size appears, usually on the surface of the liver. There is no limit to this enlargement, except that of the abdominal and chest cavities. It may grow to dimensions inconsistent with life. The cyst contains a fluid usually colorless, but sometimes stained faint yellow, of low specific gravity (1015), non-albuminous, containing chloride of sodium, but no sugar. Microscopic examination of the sediment always reveals the hooklets, which are pathognomonic. Floating in the major cyst are innumerable free cysts with attenuated transparent membranes. These are beautiful spheres as they are evacuated from the larger one, and resist the rupturing force of falling from a height. I have seen hundreds of them fall on the floor of an operating theatre, rolling about unbroken like marbles as they spilled out of the abdominal wound.

While some cysts may have a large part of their contents composed of the minor sacs, others have but a few, the fluid part predominating, but usually an innumerable crop of small cysts and scolices are then attached to the lining-wall. This lining membrane may be as thin as an amniotic sac, or so thick as to resemble wet chamois leather. It is loosely adherent to the distended liver-tissue surrounding it, so that it may easily be stripped out of its bed without hemorrhage.

These cysts are almost always single, though occasionally two or three are found in the same liver. A case is reported in the New York Pathological Society's report where a very small cyst the size of a pea, containing ecchinococcus hooklets, had grown in the wall of the common bile-duct and by its pressure produced fatal cholæmia.

As a rule, however, the symptoms of the tumor are negative until its size renders it of importance. If the growth becomes excessive, its upward projection may crowd the diaphragn, expand the chest-wall, and threaten the patient's life with dyspnœa, or, crowding the stomach by downward expansion, distend the abdomen. In one such case I relieved a lady from impending death by laparotomy and enucleation of a cyst containing one gallon.

If left untouched, there is danger of accidental rupture, as has often happened from a blow in sparring or falling. The natural course of spontaneous rupture, nature's method of cure, is to burst into the nearest cavity, a course upward through the diaphragm and evacuation through the lung being most common. In such cases the fluid or small cysts are coughed up and the disease suspected.

Next in frequency the peritoneal cavity is invaded with fatal result, and in about as many cases the cyst ulcerates into the alimentary tract and its contents are either vomited or passed by stool.

Finally, intracystic pressure may cause pointing toward the skin, where adhesive inflammation and perforation occur.

Not infrequently the contents of the cyst are contaminated from the intestines and an abscess forms involving the entire cavity. If suppuration of an hydatid occurs—which is not infrequent—the patient experiences all the effects of an abscess of the liver—hepatic pain, rigors, sweats, fever of perhaps 101° F., altered complexion, perhaps jaundice, though usually not.

If the sequel leads to bursting through the lung, the pleura is usually contaminated in transit, and a local empyema, shut in by lymph-barriers and discharging into a bronchus, follows. The patient then coughs up pus containing remnants of ecchinococci, the hooklets of which should be repeatedly searched for in questionable cases, one examination rarely sufficing.

If incision of the empyema is now effected, the pus discharged will probably contain many of the daughter-cysts from the parent sac, which resemble thin white grapes mingled in the pus.

The **diagnosis** of a hydatid cyst depends on the shape of the growth, its feeling of elasticity, absence of fever and pain, and sometimes on perception of a peculiar fremitus or crepitant thrill which is felt beneath the hand on sharp pressure downward or on tapping at another point with the other hand. Finally, aspiration of a characteristic fluid and discovery of hooklets in the sediment confirm all.

The enormous experience of those practising in countries where this disease prevails, as in Australia, Iceland, Russia, etc., enables one to assert positively the value of remedies at one time or another in vogue.

Mr. Davies Thomas in his review of a large experience says that 60 per cent. of cases of hydatids are found in the liver, 12 per cent. in the lungs.

The methods of the past that have one by one given way to the advance of surgery have been—first, the use of caustic pastes to destroy the tissues over a prominent point of the tumor (Recamier's method), producing thereby adhesion of underlying layers of peritoneum, etc., and entering the cyst after a week or more. Vienna paste applied every other day was a favorite caustic. This has had its day, and, though

successful, is extremely painful and not without danger. It was perhaps the safest method in vogue fifty years ago.

It was supplanted by the use of the trocar and cannula, which was advocated not only to empty the cyst, but by their being left *in situ* for a few days to bring about adhesions fastening the visceral to the parietal peritoneum, establishing thus a permanent fistula, which usually cured the trouble. This method, however, had some elements of danger in leakage about the cannula if the cyst was deep, and in exciting fatal peritonitis at times if the methods were unclean. Thomas's statistics of death-rate for tapping represent 26 per cent. Other vicissitudes, such as hemorrhage and suppuration of the cyst, combined to make the method one of no slight risk. It was modified by inserting two or three cannulæ in a row, and after adhesions had formed incising freely between them. This had the effect of hastening the evacuation and healing.

The trocar was supplanted by aspiration with a fine needle, which has held its own against other methods until recently. It was claimed by those of great experience that a single aspiration usually sufficed to cure by destroying the life of the ecchinococcus—that the cyst shrivelled up and the patient could feel it no longer. This result has also been claimed for puncture by electrolytic needles without evacuation, and for the method of evacuating a small amount of the fluid and replacing it through the same hollow needle by tincture of iodine or solution of bichloride of mercury, designed to act as a tænicide. Excepting simple aspiration none of these methods have been of value enough to be accepted. Aspiration alone has undoubtedly been the most serviceable, but it has been distrusted as to its results, and it has associated dangers as well. Its plausibility was sustained because in a few weeks or months most patients passed from view and were supposed cured. A much longer period, however, is required before a cure can be reported, and it has been observed that repeated aspirations are often necessary. Nevertheless, the cure of single hydatid cysts by death of the ecchinococcus and atrophy of the sac is not infrequently seen in post-mortems in non-operative cases, so that one may give credence to a considerable number of cures by aspiration. Nevertheless, it has its risks. Peritonitis was not uncommonly seen, with fatal leakage or suppuration of the cyst in some. Experience has therefore been accumulating to show, as Clutton says, first, that the method is not without danger; second, that it is not always successful; third, that it is not radical.

The method has now been superseded, like those which went before it, by a more radical one. This, it may be said, should be resorted to in every case where competent surgical aid can be obtained. The method of procedure should be as follows: An incision proportioned to the size of the tumor should be made in the linea alba if the cyst is reasonably central in position, and over the prominence of the swelling. The shining cyst-wall, not unlike an ovarian tumor, will be found close beneath the abdominal wall in most cases. Occasionally a thin layer of liver-tissue may be spread over it. Subsequent steps in either case are the same. Some advocate arresting the operation at this stage, packing gauze around the exposed front of the cyst, or even stitching it *in situ*, and waiting three days for adhesion to seal off the general cavity (Volkmann's method).

This procedure is unnecessary, and should now be abandoned for the complete operation in one sitting (Lindermann's method). Having exposed a sufficient surface of the tumor for manipulation, flat sponges or sterile gauze pads should be inserted within to absorb possible leakage. A trocar is now inserted and the cyst drained, while an assistant presses the lateral abdominal walls to keep contact between cyst and wound. When it is emptying the trocar will need to be frequently moved to obviate blocking by the daughter-cysts. As the sac becomes flabby it is seized by flat forceps that will not tear, drawn to the surface, and freely incised to admit the operator's hand. The evacuation is now easily completed. The lining parent-cyst is found to be loose, and should be dislodged and cleaned away entirely. In fact, it obtrudes itself in the aperture, having but loose cellular connection with the condensed fibrous tissue constituting the outer casing. No hemorrhage occurs, to speak of, owing to the non-vascular union of this foreign cyst with its envelope. The incision is now cleansed with sterile water and the opening stitched to the abdominal wall, a rubber drain-tube and iodoform gauze being lightly placed in the site of the cyst. The abdominal sponges and pads are now removed and counted, and the lower part of the wound closed. A rather voluminous sterile dressing is applied over all. A sinus soon remains in a rapidly-closing cavity, and a radical cure has been safely completed. If the cyst occupies the lateral portion of the great lobe of the liver, it will appear prominently beneath the ribs, bulging the chest-wall and intercostal spaces. It will be necessary to remove it then through the lower chest-wall, and it will not be possible to do this through one intercostal space.

Resection of the tenth and eleventh ribs for about three inches in the anterior axillary line will not open the pleural cavity. An ample incision between these ribs will give a large space for work. The diaphragm will be found thinned out by pressure, and possibly adhesion between parietal and costal pleura, though this is not the rule. Hence the same precautions here as in a median incision. If the pleural cavity is accidentally opened, the air enters and the lung will recede, but not to collapse against the spine, as might be feared. A moment must be spent in stitching the diaphragmatic and costal pleura together, without fear of leaving air in the pleural sac if it be aseptic, as it will be absorbed.

While the accident of ruptured hydatid cyst flooding the peritoneal cavity is a fatal one, it has been successfully met by prompt laparotomy, as in a case recorded by Marmaduke Shield. The symptoms in this case were sudden attack accompanied by vomiting and collapse, with evidence of local trouble in the tenseness of the right rectus muscle. The abdomen was cleansed of the clear hydatid fluid and a cure effected.

Cyr's statistics show the result of rupture into the peritoneum fatal in 90 per cent.; into the pleura, fatal in 80 per cent.; into the bile-ducts, 70 per cent.; into the bronchus, 57 per cent.; the stomach, 40 per cent.; the intestines, 16 per cent.; through the abdominal wall, 10 per cent.

Abscess of the Liver.

Under this general head we must consider a variety of suppurative processes distinguished by widely different causes—those of the gall-bladder and biliary ducts dependent on microbic inflammation extending from the mucous membrane of the bowel along the bile-channels; those resulting from irritation and ulceration of gall-stones; those extending into the hepatic substance from deep cholangeitis; those due to infarctions of pyæmic origin at a distance, passing through the lung and reaching the liver by the hepatic artery; and finally so-called "tropical" abscess, of amœbic origin.

Besides these, abscesses of the hepatic tissue may result from proximity to an ulcerative process set up in a diseased wall of the stomach or intestine, which, becoming adherent, contaminates the parenchyma of the liver, is absorbed by the sluggish portal circulation, and results in an excavation often of large proportions. In this latter variety only is a mixture of gas and pus ever found.

Abscess of the Gall-bladder.—So-called empyema of the gall-bladder is a sequel of infective catarrhal inflammation spreading from the papilla of entrance in the duodenum. It claims prominence because of its relative frequency and its gravity. It is most often seen in cases of chronic biliary disturbances or as secondary to malignant enlargements, or pressure of even small tumors upon the ducts. It sometimes is found in children where worms have entered the bile-ducts, or in adults from liver-flukes or distomata in tropical countries. It is associated with acute symptoms of inflammation, it may be with rigor and sweatings. Fever ranges from 101° to 103° F. Marked tenderness and, usually, enlargement are found over the gall-bladder. The patient has subjective pain, and often every evidence of acute peritonitis localized in the right hypochondrium. The right rectus muscle and the adjacent parts of the oblique and transversalis overlying the fundus of the gall-bladder will be found much more rigid than on the left side. The attitude of the patient is one inclined to the affected side.

The **symptoms** are readily appreciated when one looks within and finds the distended viscus filled with bile, turbid with catarrhal inflammatory products (or with pus in a later stage), and coated on its peritoneal surface with lymph. Its walls are much thickened by congestion and infiltration. The catarrhal inflammation extends far up the hepatic channels into the liver, which itself is usually engorged. Its natural termination is unfavorable to the patient in the great majority of unoperated cases, though the gall-bladder may become adherent to the abdominal wall or viscera and discharged by ulceration. The patient is usually exhausted by the infection before this favorable end is reached.

Treatment.—Every case requires prompt operation as soon as recognized. Formation of adhesions should never be waited for. The one step in the operation to be emphasized is the evacuation of the distended viscus by aspiration as soon as it has been reached and the surrounding parts protected. Free incision, and drainage by rubber tube as large as one's finger placed in the gall-bladder and surrounded with iodoform gauze packed into that organ, as well as about it, will ensure the perfect

protection of the abdominal cavity. The first profuse discharge of purulent fluid drains the hepatic ducts, and in a few hours pure bile flows freely.

Abscess with Gall-stones.—The same history as that of catarrhal empyemas of the gall-bladder may ensue if gall-stones be present. It is perhaps a little more often associated with stones than not. Yet while the latter are reposing in the viscus or descending in the canal they can induce no infection. It is only when an ulcerative process is started that the colon bacillus penetrates the adjacent inflamed intestinal wall or enters in through the papilla, and abscess follows. In such ulcerations the outlet is already formed, and the gall-bladder spontaneously evacuates without harm.

It not infrequently happens, however, that the channel into the bowel closes over one stone before others have escaped, and the infection provokes an accumulation of pus that spreads in the direction of least resistance. Hence such irregular abscesses discharge through the navel, the groin, the lumbar regions, or elsewhere, and are slow to heal. Not infrequently an intermittent discharge of gall-stones continues for years through an old distant sinus.

Pyæmic Abscesses.—The true pyæmic abscess is always multiple. Wounds involving any part of the body, notably the upper extremity or scalp, which become infected and beget general pyæmia, are associated with subacute symptoms with characteristic cachexia, sweetish breath, sweating, chills, hectic fever, and will often be found to develop hepatic abscesses with, usually, no marked symptoms, except occasionally a little enlargement and tenderness. On post-mortem section each slice of the knife opens several small abscesses containing pus, perhaps a drachm or so each. These result from embolic infarction of septic micrococci colonies carried through the hepatic artery. They must have travelled from the original infected point by venous channels, traversed the lung, and entered the general arterial circulation. Hence we find, according to Waldeyer, that hepatic-infarction abscesses are found in 6 per cent. of those dying of surgical pyæmia, and pulmonary abscesses in two-thirds of the cases. Klebs also asserts that such abscesses are four times as frequent in the lungs.

It is evident, then, that for pyæmic hepatic abscesses surgery is practically unable to offer relief.

Traumatic Hepatic Abscess.—In broken-down or unhealthy subjects it seems possible for an injury to the liver to result in abscess, as illustrated by a case of Bryant's, recently reported, where a drunken woman suffered a kick in the right lower ribs, followed by bronchopneumonia and death in the fourth week. The liver beneath the injury showed a large abscess containing broken-down liver-tissue, blood, and pus, doubtless contaminated from the systemic circulation.

Tropical Abscess of the Liver.—The most usual form of hepatic abscess is the so-called "tropical abscess," which has only very recently come to be understood. It is now a question whether all abscesses except those types mentioned in the foregoing pages are not of the variety now to be discussed. Heretofore "malaria," "congestion of the liver," and "hepatitis" have been assigned as adequate causes of abscess-development. These do not now satisfactorily explain the eti-

ology of this disease and may be banished from the list. It was usually ascribed to "congestion of the liver in a patient addicted to spirits and exposed to chill in a tropical climate." Pathology does not recognize "congestion" or "hepatitis" as competent to cause purulent degeneration without infection, and there is no evidence to show that pure malarial infection has caused it. The prevalence of hepatic abscess in Egypt, India, and the tropics had given ample opportunity for its study, but it must not be forgotten that the same disease, though much less prevalent in cooler countries, presents the same phenomena there and may originate in the same cause.

The association of tropical abscess with tropical dysentery has lately received close study. Not all cases of abscess are preceded by a clear history of dysentery, but Riener and Kelsh found that in 314 cases 85 per cent. were associated with it. It is doubtful if its less frequent occurrence elsewhere than in the tropics indicates any difference in etiology. In the Southern States both occur, but as we approach cooler climates they become less common.

The constant coincidence of amœbæ coli in the dysentery of hot climates, discovered by Koch when investigating cholera bacillus, and their presence in and beneath the ulcers of the colon, awakened a new interest in the subject. Prior observation on these parasitic amœbæ had been made by Lamb in 1859 in studying the mucus from the bowel of a child. Lösch of St. Petersburg and Kartulis in Egypt made extensive confirmatory studies. The latter found it present in 120 dysentery cases, and, extending his examination to the associated hepatic abscesses, found it also in them—in every one of twenty cases (1887).

On the other hand, the pus from hepatic abscesses was found sterile of bacteria in more than half the cases, while in others staphylococci and streptococci were found. Kartulis held that pus and amœbæ pass into the liver through a blood-vessel, where the pus-forming bacteria usually die and the amœbæ survive.

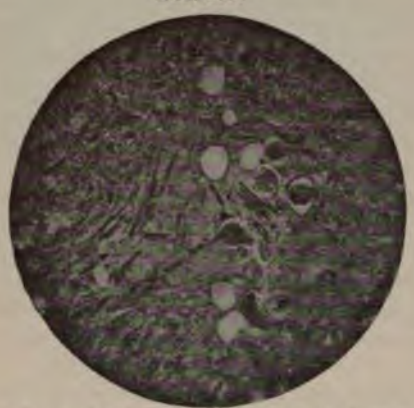
Councilman, Osler, Lafleur, Zancarol, and others have verified this in many cases, and found amœbæ in enormous quantities in the colon ulcerations, in the submucosa, in the fat of the adjacent mesentery, and finally, in the abscess-contents and the breaking-down hepatic tissue constituting its wall.

Zancarol, after twenty-seven years' experience in the Greek hospital at Alexandria, subjected 14 recent hepatic-abscess cases to more careful examination, and found 6 contained amœbæ, 8 did not. In all there were in addition streptococci, staphylococci, or bacilli coli communis. The pus he finds often sterile to culture, though capable of infection by experimental injection into the rectum of a cat. The cat has colon ulceration and hepatic streptococci abscesses when killed a few days later.

In cases where it has not been possible to discover the amœbæ in the fluid drawn from an hepatic abscess they have been found later in the liver-tissue. In cases where a preceding dysentery was denied, a subsequent history of mild colitis months previously has been gotten from the patient, and cicatrices of ulcers discovered. Immediate coincidence between dysentery and abscess is not essential, therefore, as etiological proof.

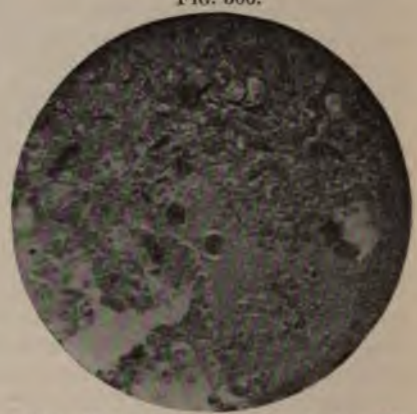
It is important to know that the amœba is comparatively easy to recognize by a moderate power. In size it is many times larger than a

FIG. 305.



Section of liver adjacent to hepatic abscess, showing four well-defined amœbæ (several white spaces from which others have fallen out will be seen). Dark nuclei of pus-cells and some unchanged liver-cells are on the right; on the left, necrotic liver-tissue and detritus.

FIG. 306.



Section of liver-tissue at the edge of an amœbic abscess. In the centre two well-marked amœbæ surrounded by a necrotic zone; above are some unchanged liver-cells; below, only detritus and abscess-cavity commencing.

blood-corpuscle, as will be seen by the illustration annexed. If a smear be made upon a slide and covered with a thin glass, and kept upon a warm stage (easily made by a perforated strip of tin extending beyond the stage to a spirit lamp under one end) the active motion of the amœba will be seen. In some cases great motility is observed, even hours after the fluid is removed. It stains best with saffronin and hæmatoxylin.

In cases of hepatic abscess spontaneously discharging through the lung, Osler has diagnosed the same by finding amœbæ coli in the expectoration.

In view of these recent discoveries it is evident the old views of the cause of liver-abscess must be altered. No ordinary hepatitis degenerates into abscess. It has been found by Kartulis that in the majority of cases the abscess-contents are sterile of pus-forming bacteria.

The peculiar character of the discharge, which has always been unexplained, is now understood better. It has been spoken of as chocolate-colored or resembling anchovy sauce, though sometimes it is yellow. The characteristic fluid has very few pus-cells in it, but mostly detritus of liver-tissue, granular matter, or sometimes more gelatinous material. In other words, it is rather the result of necrosis of liver-tissue due to such chemical changes as are induced by the presence of the amœba.

This explains also the characteristic feeling which the finger encounters on entering the abscess-cavity. The walls are soft, pultaceous, and offer little resistance to the finger, which sweeps from them mushy fragments of broken-down liver. The definite walls usual to abscess-formation are wanting, and examination shows "no boundary of fibrous tissue and a remarkable absence of leucocyte-infiltration" (Galloway). This accounts for the absence of pus-corpuscles in the fluid contents. In the stained sections from the walls are seen the well-preserved rounded

or pear-shaped amœba-cells in the midst of obviously necrosed liver-cells.

This description answers as well for the cases of the disease seen in cool as in hot climates, and there can be no longer any doubt as to their identity.

Symptoms.—Aside from the fact that active dysentery or colon ulceration need not be present, the symptoms are not always striking, but in the typical case there are usually rigors and sweatings with a not very high fever (102–103° F.), remitting in character, but not with regularity. There is a sense of soreness and weight on the right side, and if the abscess be on the upper surface a short cough and a stitch on inspiration, some dyspnœa, and a right shoulder-blade pain, but if on the lower side more gastric disturbances, vomiting, hiccough, and sometimes jaundice, though this latter is rare.

Locally, hypochondriac bulging is seen in superior abscesses, and epigastric or subcostal in inferior ones. When central or posterior, the gross bulk of the organ is enlarged. Fluctuation can almost never be felt. The hepatic abscess is usually single, 62 per cent. occupying the right lobe; Zancarol estimates 75 per cent.

The natural course is to a fatal termination. Cyr found that in 563 cases 55 per cent. die without bursting or being operated on: 10 per cent. burst into the lung; 7 per cent. burst into the peritoneum; 5 per cent. into the pleura; 2 per cent. into the colon; and a few into the stomach, vena cava, kidney, or pericardium. The usual rupture is into the right lung, setting up empyema and discharging through the bronchus or intercostal space. Such cases often recover spontaneously after tedious and exhausting illness. Rupture into the peritoneal cavity is uniformly fatal.

The **diagnosis** of hepatic abscess may be confirmed by aspiration, but with no idea of its being cured by emptying it of its contents. Aspiration, if it prove the presence of pus, must be speedily followed by free incision.

It has been disputed whether aspiration is justified in view of possible leakage into the peritoneum following withdrawal of the needle. In its defence it may be said that the pus is most often sterile, and not very likely to give trouble, and that if the needle traverses an inch or two of hepatic tissue, its withdrawal is followed by complete closure, especially if there is no longer pressure within the abscess.

Aspiration should be done in the axillary line—the ninth, tenth, or eleventh interspace.

If the pus is aspirated out, it is always seen to have blood mingled with the latter part, and has to be repeated at short intervals.

In most cases it has to be followed by incision and drainage before a cure.

All **treatment** has now given way to the knife, which should be resorted to as soon as the trouble is recognized. The same rules as to location and method are to be applied here as have been described in speaking of hydatids. The incision cannot be too free, thus ensuring the peritoneum from soiling. If liver-tissue covers the abscess, it is well first to stitch the liver to the parietes by deep stitches before incising.

Packing the cavity with iodoform gauze as soon as it has been evacu-

ated and mopped out with sublimate solution, tincture of iodine, or salicylic acid will give the best chance to secure the liver from further invasion. The great majority of cases so treated will recover.

If a chronic discharge has taken place through the lung, it is best to aid nature by an operation for empyema, and the liver will discharge and cure itself through that.

Volkmann's method as for opening hydatids, in two stages by inducing adhesions first, has been supplanted by the continuous completed operation.

Gall-stones (Plate IX.).

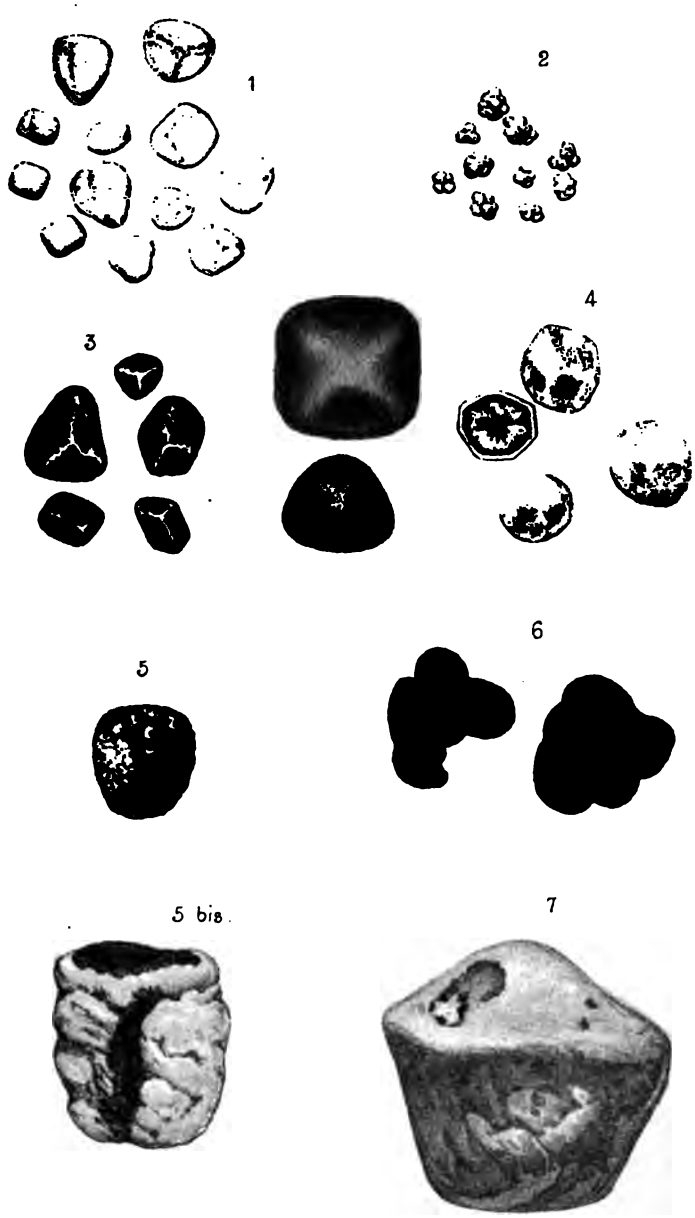
The presence of biliary concretions in the gall-bladder in view of the importance of the surgical aspect of the subject deserves a brief consideration of the composition of such concretions and of the fluid from which they crystallize.

The anatomical relations of the gall-bladder and ducts have been already considered, but it is important to observe that the desquamation of the epithelial cells and abundant mucous secretion of the glands with which the gall-bladder is liberally provided play an important part in the development of gall-stones. The gall-bladder is a reservoir merely serving to store the bile and allow of its slow discharge into the intestines. It has been difficult to reconcile the apparent superfluousness of this fluid with its necessary storage. The horse and some other animals have no gall-bladder, and to all intents and purposes it is evidently of little or no utility in man. When it is entirely removed his digestion and nutrition go on just as well. Furthermore, the absence of bile from the intestines, as in cases where it is entirely removed by external fistula, is consistent with perfect health. Indeed, when reabsorbed into the system it is a distinct poison, being, according to Bouchard, nine times as poisonous as urine. The liver may form bile enough in eight hours to be fatal if it be all absorbed. In other words, it seems to be wholly excrementitious. Physiological experiments seem to show that it is in some way a slight but unnecessary aid to the pancreatic secretion in emulsifying fats.

The amount daily excreted is one pound. This I have watched for weeks in a case of biliary fistula with complete obstruction of the common duct. Patients discharging all bile externally, as a rule, notice no difference in their daily health or bowel function, unless it be an occasional tendency to flatulence, which may be corrected by the administration of dried ox-gall in capsules, ten grains at each meal. The composition of bile allows of a separation of solid ingredients—cholesterin (which constitutes 2 per cent. of normal bile), bilirubin, or calcium carbonate—in the presence of certain altering and irritating substances. Such, at least, is all that can be said from a study of the nuclei of gall-stones. In them is found a group of degenerate epithelium cells or mucus or viscid liquid, in which at times a bacillus resembling coli commune appears, sometimes permeating the stone.

The development of the calculus seems to depend on crystallization of the excess of cholesterin and bile-salts, possibly due to temporary stagnation and absorption of water by the walls of the organ, possibly to a transient catarrh of the mucous membrane, or, as Robson calls it, a

PLATE IX.



TYPES OF GALL-STONES FROM THE AUTHOR'S COLLECTION (Exact Size).

1. Unusual Type, Pure Cholesterine, Pearl Colored. 2. Pure Cholesterine, like Mustard Seeds. 3. Usual Type, Predominance of Bile Coloring. 4. Cholesterine, with Varying Amounts of Pigment Coated with Lime Salt. 5, 5 bis. Types of Stone Removed in Grave Obstruction of Common Duct, mixed lime crusting. 6. Irregular Form, Deep Licorice-like Bile Coloring. 7. Enterolith, Escaped Gall-Stones Removed from Intestine above Ileocæcal Valve.

"desquamating angiocholitis." As far as any judgment can be formed at present, the causes are two—stagnation and a morbid state of the epithelium. It has been shown by Naunyn that the epithelial cells lining the gall-bladder exude a gelatinous substance readily changed to cholesterin crystals by acetic acid. This fact, in conjunction with the observation that pure cholesterin-stones will increase in a gall-bladder after occlusion of the cystic duct, accounts for their appearance almost exclusively in the gall-bladder.

The calculi vary as much in size as in composition and color. The smallest are like grains of sand, and have been counted up to over seven thousand in one gall-bladder. It is not infrequent to find one or two hundred of the size of bird-shot, but by far the most usual of the cases falling into the surgeon's hands are those containing from one to ten, varying in size from a chestnut to a walnut. In color they are of pearly-white or asbestos-like appearance, shining with cholesterin crystals, or yellow and round like mustard-seed, or greenish-gray, dark brown, or, finally black, looking and feeling as if formed of dried licorice extract. The variations depend on the amount of coloring matter. In hardness they vary also, from being so soft when of pure cholesterin type as to be easily crushed in the fingers, up to the hardness of a vesical calculus, in which case there is an admixture of lime salts precipitated by inflammation.

The great prevalence of cholelithiasis is shown by post-mortem statistics, which reveal its presence in vast numbers of people having no previous suspicion of its existence. The statistics vary in different communities, but on the average one individual in ten is affected (Naunyn). Yet Paulsen says that in Denmark in over nine thousand autopsies there were over three hundred gall-stone cases, or about one in thirty.

The percentage of those in whom post-mortems reveal their presence shows that in advanced age they are much more common, so that after sixty years one person in six is affected.

In women the disease occurs in a greater number than in men—the ratio of 5 to 2. This has been explained, for want of better reason, by tight-lacing and bile-stagnation.

It is notably true that when cancer of the ducts is present, gall-stones are more often found. Zenker found them in 85 per cent. of the cases of cancer. This and other pathological grounds have led to the generally accepted theory of their presence or passage being the occasion of cancer-growth. The absence of stone is of course to be expected in many cancer cases, because its very irritation in transit led to the trouble, which only came after its expulsion.

While the gall-bladder is often distended by stones facetted and lying together like beech-nuts, the patient is unconscious of their existence until one attempts the passage of the cystic duct. Then begins the trouble that is only rivalled by labor. The muscular coat of the duct grasps the stone, and active peristalsis of the entire canal and wall of the gall-bladder begins. Irritation engenders seretion, and an additional fluid poured out into the gall-bladder adds a *vis a tergo* which ends in expulsion. The cystic and common duct endure a dilatation proportionately greater than the parturient canal. The ducts, which are of the size of a very fine quill, easily suffer dilatation, so that the index finger

passes readily in, and in the surgeon's experience a stone as large as the end-joint of one's thumb may be found in any part of the canal. Rokitansky records one the size of a pullet's egg which he found half extruded into the duodenum.

Nature is not always so successful, however. In her expulsive efforts a relatively large number of patients die while awaiting nature's ambitious ending. In a large proportion of cases a pathological change is seen which in nature's wonderful provision accomplishes by another route what she would fail in if the attempted expulsion by the papilla were persisted in. That process is ulceration, by which the wall of the canal is penetrated by pressure of the stone, and, having time to seal itself by plastic adhesion to a neighboring organ, penetrates that also and discharges the stone into the duodenum, stomach, or colon. Unfortunately, this beautiful scheme sometimes miscarries, and the discharge takes place into the peritoneal cavity or other vital parts, sacrificing the patient's life at times. The slowness of the process, however, enables the discharge to follow the direction of least resistance or where guided by natural barriers. Hence we find it discharging sometimes at the navel, having followed the round ligament of the liver; sometimes in the loin or in the inguinal region.

The **symptoms** of an attack, which means the passage of a stone, can be almost predicted when one considers the process as just narrated. A sudden onset is almost uniform. Intense pain seizes the patient under the right ribs, often shooting through to the shoulder-blade. Nausea, fainting, vomiting, sweating ensue. The pain abates and returns; paroxysms compel the patient to double with pain. There is no fever. The attacks endure from a half hour to two days, but, as a rule, are ended in twelve to twenty-four hours.

It is probably true that with few exceptions all frequent attacks of pain which are located beneath the right lower ribs and are attributed to indigestion pains are due to the passage of very small stones, of which post-mortems reveal so many unsuspected cases. Too much emphasis cannot be placed upon the absence of acute colic at the onset of a slow-advancing jaundice as indicating malignant or inflammatory obstruction.

The surgeon's special interest is with cases of constantly repeated attacks which call for interference either because of frequency, severity, or disablement. It is not uncommon to see the morphine habit established because of frequent need of its administration. One such case of ten years' standing I have relieved by operation, and after three years the patient had still not returned to the habit.

It is a matter that rests entirely with the patient to say when the surgeon shall step in. But with the faith in the safety of operative procedures born of recent experiences one may now confidently advise operation in cases of even moderate disablement.

The risks of leaving calculi are not small. Fever of a septic type, associated with jaundice and strongly resembling ague attacks, are to be recognized as due to arrest of the calculus partly obstructing the common duct, eroding its epithelium, allowing absorption, and leading to a train of symptoms that are a menace to life and health.

The passage of very large stones painlessly is not uncommon, as shown by their discovery in the bowel as obstructing enteroliths without

previous history of colic. Such transit from the gall-bladder must always be by ulceration, and, moreover, by ulceration into the duodenum, inasmuch as these stones are usually found in the narrowest portion of the ileum within a yard of the ileo-cæcal valve.

The presence of glycosuria in connection with some gall-stone diseases has been shown by Ord to be due to functional pancreatic disturbance through solar-plexus irritation. It disappears directly after the stones are removed and is no contraindication to operation.

Gall-stones are not uncommonly vomited, in which case they have returned through the pylorus rather than ulcerated into the stomach, as has been shown by post-mortem.

"When is a stone hopelessly impacted so as to require operation?" is a question of less importance to-day than in the past. The surgeon does not do his duty by the victim if he waits for him to be nearly exhausted. The results of operative relief are so uniformly good in uncomplicated cases that to await is only to invite complications. It will never be possible to assert that the last stone has left the gall-bladder after three or four attacks, and one may now place the operation in the interval or during an attack on a higher plane of safety than that for appendicitis.

Cholecystotomy.—The simplest of all operations on the biliary passages is that resorted to for draining an inflamed or obstructed bladder or to remove stones therefrom. An incision is made vertically from the tip of the tenth rib downward three inches, and extended if needed. The gall-bladder will always be found presenting when the cavity is opened. If several preceding attacks have been severe, it will probably be wrapped about and often hidden from view by adjacent viscera, the colon often presenting first. One may carefully separate everything from it by patiently teasing apart, and it should be exposed to its duct.

The bladder must first be aspirated of its contents. Protecting gauze or sponges are inserted to avoid possible soiling, and an incision large enough to allow the finger to enter is made in the bladder-wall in the direction of its axis and near its fundus. The finger is now introduced, and detects the stone as nothing else will. I have frequently demonstrated that a probe, director, or even forceps, will fail to detect by touch the usual soft cholesterin calculi. The finger alone is of use, and, guided by that, a pair of good-sized dressing-forceps with broad spoon-shaped blades constitutes the only good instrument for universal use in extracting them.

Bile continues to flow back into the bladder during operation, and requires removal if the duct has been successfully cleared. Search, however, should always be made by the finger along the common duct to detect hardness of another lower calculus.

The toilet of the parts having been made, the opening in the bladder must be brought to the peritoneum by sutures and a drainage-tube put into it secured by a safety-pin.

The lower part of the wound should be closed up to the open bladder, and ample provision made in dressing for a profuse discharge of bile. After ten days the tube is unnecessary, as the bile will flow spontaneously. In two weeks a pad may be placed over the sinus to partly dam back the bile, and if it appears in the stools a firm pad and strap-

ping will close the sinus by the end of three weeks. If the discharge continues many weeks, it is proof that some stone has been left either in the bladder, which is often sacculated, or in the common duct. It is well to wait some weeks before operating again, for nature will often work the calculus back by reverse peristalsis and discharge it at the fistula. I have seen this happen on two occasions.

Ideal cholecystotomy is a name applied to the immediate suturing of the bladder-incision by a double row of Lembert sutures and returning to the abdominal cavity. It is not generally to be recommended except in simple cases where absolute assurance is felt that the bile-channels are freely open. I have twice done it with success, but have had misgivings and anxiety from post-operative colic, which I think must have been from the passage of obstructing blood-clots, which I can conceive might be mischievous. If it is contemplated, I would recommend Wölfler's method of stitching the sutured viscus at the laparotomy wound, where, if it gives way from intracystic pressure, leakage will be harmless.

Cholecystectomy.—The gall-bladder is easily separated from the liver by blunt dissection, which gives no serious hemorrhage. A ligature placed about the cystic duct permits its removal. The utility of the operation may be questioned, as it destroys a channel by which the bile may reach the surface when deep trouble prevails. It can be advocated in beginning malignancy or when chronic atrophy has left a distorted and pocketed bladder. I have removed it twice for the latter condition with happy effect, being first certain that the common duct was pervious. If we regard the gall-bladder as the origin of gall-stones, this is a legitimate proceeding, but it would seem that a shrivelled lining ceases to functionate, and hence cholesterin-forming material is not to be feared. On the whole, it is better not to remove it. If we are sure all calculi are removed, the sinus will close quickly and the duct atrophy.

Choledochotomy, or incision into the common bile-duct, is a most important and interesting proceeding. If one keeps in mind the anatomy of the part as given previously, it is evident that by the same incision as for gall-bladder operations the deeper part can be exposed. It is well to raise the shoulder and lower the hips of the patient to cause the colon and small intestines to fall away from the operative field. The liver being held up by an assistant and the colon drawn to the median line and downward, one sponge being placed on the median side and one in the kidney pouch, an incision of the peritoneum of the posterior wall is made from the cystic duct downward on the outer side of the duodenum toward the kidney: through this the finger can lift up the first and second part of the duodenum and explore the under side of the head of the pancreas and the common duct at its lower part. If a stone be felt in the upper or middle part, it can be reached easily and isolated.

The duct lies upon the portal vein, and the cystic artery lies alongside it. The distention of the duct by a stone, however, gives little risk of cutting back of it. An incision in the length of the duct will allow the obstructing stone to be easily lifted out. I have on three occasions removed large calculi thus. The duct-wall is much hypertrophied where it had enveloped the stone and has a pink appearance, as if its muscular coat had been developed in its effort to push onward the calculus. It is

an easy matter, therefore, if one is provided with a good needle-holder or long artery-clamp and a curved flat needle, to suture the duct with a continuous suture. A second layer may be taken to strengthen the first, though this hardly seems necessary.

If the patient's condition or other circumstances do not justify a prolonged operation, it is perfectly good surgery to press the walls of the cut duct together by a gauze strip folded and packed down upon it, its end being brought to the surface, and to place alongside it a rubber drainage-tube. In a few hours all adjacent viscera will be sealed about it by lymph, excluding the bile from the peritoneal cavity. In two or three days the tube and gauze are removed and the tube replaced alone for ten days.

Cholelithotrity.—If a stone is felt in the cystic or common duct, it is the surgeon's duty first to attempt to crush it by the finger-pressure, which will break up soft stones. If it proves too hard, he should try to crush it with the compression of flat forceps, over the end of each blade of which a piece of rubber tube is drawn. Force that will not harm the duct will often crush the stone, and it may be left to nature to be carried off. Or, finally, a round needle may be used to prick the stone to bits through the wall. We are indebted to Tait for this method. These methods are all successful and harmless, except in large or hard calculi. Pain, requiring morphine, usually results during the day following, as the fragments pass down the duct.

Cholecystenterostomy.—The union of the intestine to the gall-bladder by some safe method has been the hope of surgeons during the last fifteen years, and to the credit of our decade it may now be said to be an accomplished fact.

It becomes necessary in some cases of common-duct obstruction to form a biliary fistula to obviate absorption. To return this bile to the bowel was the problem which Von Winiwarter was the first to attempt to solve. He stitched the gall-bladder to the colon and attached both to the abdominal wound. Then, waiting until adhesion had fixed them there, he cut an opening in the adjacent part of each and sutured the opposite sides of the cut together, thus attempting to compel the bile-flow to enter the bowel. After many vicissitudes he accomplished a cure.

It was several years before others repeated this operation. Experiments by Gaston of Georgia showed that in dogs a union of the gall-bladder and duodenum could be successfully done. But this was not accomplished in man until 1889, when Terrier succeeded in Paris. Meanwhile, attempts had been made by five operators with various results in different countries. Only 1 death in the first 7 cases led others to venture, and it soon became an acknowledged fact that suturing was an efficient though not an easy method.

The use of Senn's bone plates having come into vogue for intestinal anastomosis, they were adopted in the field of gall-bladder work, but to this they were less adapted.

It remained for another mechanical device to popularize this beautiful surgical operation—namely, Murphy's button, which at present has no rival.

Since December, 1892, when the first article was published in the *New York Medical Record*, up to April, 1895, when Dr. Murphy gave a

résumé of all cases he could learn of as having been done with the button, there was a record of 38 cases of cholecystenterostomy with 1 death, and that was certainly not due to the button. The cases were operated on by twenty-two different surgeons, so that the device can be said to be universally available. The writer has knowledge of others not included in his table, two of my own being perfectly successful. The invention of this simple instrument has certainly been a brilliant one, and the whole field of gall-bladder surgery has been lifted on a higher plane.

It is true it has been often resorted to where simple cholecystotomy and temporary drainage would have been equally successful; nevertheless, if it can always be safely accomplished, as now seems probable, it places in the surgeon's hands a means to an end that is not only more elegant, but from the first leaves the patient in a more comfortable condition.

It cannot be denied, however, that except by the trained surgeon the duodeno-cholic union should not be attempted when there is every reason to believe that a biliary fistula will answer the same requirement and almost infallibly close spontaneously in about three weeks. A slight experience, however, will enable every operator to use the button safely.

Cases appropriate to its use are such as cannot be relieved of common-duct obstruction by the means already described. Murphy has applied it to every case, uniting the gall-bladder and duodenum with disregard of the offending obstruction, simply emptying the gall-bladder of any stones there found and making anastomosis. The writer believes this will hardly be endorsed by surgeons generally, and it is usually wiser to attempt removal of a stone in the duct by choledochotomy, after which anastomosis is unnecessary. Cases of obstruction where haste is desirable may have anastomosis with the colon more quickly made; also those in which a chronic biliary fistula exists from stenosis of the common duct. Again, in cases of beginning cancer in the pancreas making pressure on the common duct there can be no hope for the patient's future except by a cholecystenterostomy. Of this class the writer twice made a button anastomosis with the duodenum with excellent success.

It remains yet to be decided whether the bile can be as effectively diverted into the large as into the small intestine. Every case thus far reported proves that it can. If that be true, it will become the surgeon to do that which is the safest and easiest operation—namely, unite the colon and gall-bladder.

Method of Operating.—The gall-bladder and intestine having been liberated so as to approach each other freely, the former is emptied of bile by aspiration, and a stout silk suture applied to act as a purse-string around a one-inch incision through which to remove calculi and introduce the button. Then the string is tightened round the stem of the half button, which is held *in situ* by a clamp-forceps. The same steps are taken on the face of the duodenum. The fingers of each hand grasp a half button with much care that it does not slip into the bowel when the clamp is taken off, and the two stems are telescoped, until the rims tightly fix the intestine and bladder together.

One difficulty which the operator will often encounter is the fixedness of the duodenum in the depths of the loin. In one case I found it

necessary to dissect the gall-bladder from the liver before I could turn it down to meet the surface of the gut. The later manipulation was correspondingly difficult. Hence I regard the large bowel, which naturally lies at hand, as more useful for surgical purposes.

Attempts to join the gall-bladder to intermediate parts of the small bowel are likely to create volvulus and are unwise.

As yet no reported cases of absolute stenosis of the aperture created by a half-inch button are recorded, except one. It is probable that a very minute opening sufficient for bile to flow through will be retained by natural force of the bile, in spite of the ever-working law of stenosis in intestinal fistulæ. In the case spoken of a half-inch button was used upon a lady with perfect success in relieving a complete duct-obstruction from pressure of a beginning cancer of the head of the pancreas. The patient had a sudden return of cholæmia after ten months of health and died in two weeks. The cancer had grown up so as to block the cystic duct and confine the bile to her liver. On the autopsy I made a most careful study of the parts removed *en masse*. The gall-bladder was distended with colorless mucus, no bile having passed through it for two weeks. I emptied it, tied in a syringe cannula, and distended it with fluid under pressure, but none came into the duodenum. I then opened the viscus, and found the minute contracted scar of anastomosis, and by breaking a thin barrier passed a bristle through.

It may be said that the physiological usefulness of the opening having ceased with the flow of bile, it was free to close, which it would never have done otherwise. I am inclined to fear that others will be found, later, to need renewal, although one or more cases have already passed in to the third year of freedom from trouble.

Hydrops of the Gall-bladder.

As will be understood from the previous pages, a stenosis of the cystic duct easily follows a prolonged irritation by calculus. The sequel of this may be either an atrophy of the functionally useless organ or distention with its own secretions, which its altered mucous membrane refuses to absorb. This is called dropsy of the gall-bladder, or hydrops. It is an innocent cyst unless by its size it gives pain or pressure-symptoms. The fluid drawn from it by aspirator is either slightly opalescent from desquamated cells or it may be clear as water. It is curable at once by cholecystotomy.

Biliary Fistulæ.

Two varieties may be noticed—one from which bile constantly flows; the other from which no bile comes, but a thin purulent discharge and occasional gall-stones. The former owes its continuance to either a blockade of the common duct or the persistence of a stone near the fistula outlet, combined with such a large cystic duct that the bile more easily flows out through it than through the papilla at the duodenum.

In this case experimental pressure on the fistula will force bile into the intestine, and it will be discovered in the stools on the following day. The sinus should therefore be reopened, search made for the stone, and

the lips of the opening confined by strapping, which will usually result in a cure.

If the discharge persists, laparotomy should be done, the atrophied gall-bladder dissected away, and cholecystenterostomy done.

If calculi and pus discharge alone from a distant fistula, it is plain that the cystic duct is obliterated. A free incision can then be justly undertaken, and the gall-bladder, which will be shrunken and contain the undischarged calculi, should be removed entire. The tortuous sinus, being syringed out and drained, will spontaneously heal.

SURGICAL DISORDERS AND DISEASES OF THE UTERUS.

By WILLIAM M. POLK, M. D., LL.D.

Injuries of the Uterus.

The position of the unimpregnated uterus is such that it is rarely injured, except as the result of gunshot or stab wounds or in consequence of the incautious use of a sound or curette. Gunshot wounds are merely a part of a more extended injury inflicted by the missile in its progress through the body, and the treatment likewise forms a part of that which the adjacent or superimposed viscera may require in consequence of such damage as they may have received. If the uterus has only suffered superficially and if there be no bleeding, the wound may be ignored; but if there be hemorrhage, this should be controlled by fine silk sutures passed deeply into the tissue in such manner that when tied the edges of the wound are closely approximated. If the injury should be at the sides of the organ, it is possible that mere approximation-stitches will fail to stop the bleeding: it will then be necessary to pass deep ligatures, one above and one below the wound, which, being tied, will accomplish the purpose. If the cavity of the organ has been punctured, it is safer to remove it altogether, for the danger of septic infection of the torn and bruised surface by the secretions in the cavity is very great. As time in such cases is an important element, it would be best to perform the partial rather than the complete operation; that is, amputate the organ at the cervical juncture, having first secured the four vessels which feed it. For the details of this operation we refer the reader to the section of this article which deals with hysterotomy.

Stab wounds differ from shot wounds in that they are simply punctures or incisions, and when of limited extent require nothing more than suturing. If important vessels be severed, they should be ligated by deep sutures placed above and below the point of injury. If the cut is so extensive as to wellnigh amputate the organ, it should be removed after the manner suggested above.

Wounds with the sound and the curette are usually of small extent—simple punctures; as a rule they can be left to care for themselves. This does not apply, however, to openings made through the wall of the uterus in cases of cancerous diseases. Owing to the fragile state of such a wall these openings are apt to be large; and when to this is added the septic properties of fluids which exude from cancerous growths, we realize that a very dangerous wound may have been made. Such wounds demand the removal of the uterus at once.

Wounds of the impregnated uterus are more common than wounds

of the unimpregnated organ if we exclude injuries with the sound and the curette. The relation of the pregnant organ as it rises from the pelvis to the abdominal wall explains this difference in part, for it is exposed to accidents such as blows, kicks, stabs, shot wounds, gorings, falls, etc., to the influences of heavy lifting, and to the strain of dancing. Breaches from the latter causes would seem, however, to be aided by some prior degeneration of the uterine walls, such as a fatty change. In addition to these mischances, the uterus is now and then ruptured in labor and through the malpractice of the abortionist, and occasionally through the error of the surgeon, who taps it supposing it to be an ovarian cyst.

Injuries to the body of the pregnant uterus rarely fail to empty the organ, but the immediate concern is with the wound. Gunshot and other puncturing wounds demand prompt laparotomy. This will expose the organ and permit us to deal directly with the injury. If the fœtal sac has escaped puncture, it is only necessary to control bleeding and suture the wound as in Cæsarean section. The control of bleeding is often far from easy: it may be readily done, however, if it comes from one of the main vessels, by merely tying the two ends, but should it come from the wall the task is more difficult. If the suturing necessary to close the wound cannot be made to act as the hæmostatic as well, then nothing short of Cæsarean section will suffice. This, if done, should be carried out in the manner to be described under that head. As falls or blows upon the abdomen may rupture the organ without break of the external surface, one must be guided in action by the condition of the patient. Hemorrhage will be indicated by the usual symptoms of that condition, and rupture of the organ can generally be made out by conjoined palpation, the patient being anæsthetized if necessary. If either condition be proven, the abdomen should be opened, and one's action should then be based upon what has been already said as to wounds of the uterine wall. In all of these cases of injury, should any part of the contents of the fœtal sac have escaped into the peritoneal cavity, it should be carefully removed, and after closing the wound in the uterus or removing the organ entire, as may be made necessary by the great extent of the rent in the wall, the incision through the abdominal wall had better be closed only in part, a good portion of it being left open for drainage, gauze being packed into the opening extending through the cul-de-sac if the uterus has been removed, or to the wound if the organ be in place. This same open method of treatment is advisable in gunshot and punctured wounds if perforation of the viscera has formed a part of the injury.

Tears of the pregnant uterus from within outward may occur as the result of a difficult labor, as in obstructed labors, or as a part of the malpractice of the abortionist. We refer more particularly to injuries of the body of the organ, because injuries to the cervix, the most common form of injury in parturition, will be treated of in another part of this work.

The injuries inflicted by the abortionist are in the nature of punctures and lacerations of the walls. Simple punctures, provided sepsis does not supervene, may cause little or no danger, but wider breaches have been known to lead to prolapse of the intestine through the rent, with

subsequent strangulation of the gut. The proper measure in such extreme cases is the removal of the uterus if the patient's condition permits it, and where the gut is gangrenous the resection of the diseased part. If for any reason the uterus cannot or should not be removed, even from below, the rent must be closed from above the pubis and the open method of treatment be adopted. It is perhaps needless to say that should the uterus be left in place its cavity must be carefully cleansed and free drainage by gauze packing provided for.

Rupture of the uterus during labor is not a common accident in the United States—occurring only about once in three thousand labors—but when it does happen and is complete it is a very serious complication. Over 90 per cent. of the children are born dead, and fully 60 per cent. of the mothers succumb. It is the result of forced and of obstructed labors. Types of these several conditions are found in versions in high-forceps delivery, in transverse presentations, hydrocephalus, deformed pelvis, soft or bony tumors within the pelvis, cancerous or other degenerations, and constrictions of the cervix and lower uterine segment. In all obstructed labors the normal expansion and thinning of the lower segment of the uterus are exaggerated, and this may go on to extreme attenuation, needing but slight additional force to tear it. This, in truth, is the great underlying cause of rupture in labor.

Rupture may be complete, extending through every coat, or incomplete, the peritoneum or the mucous membrane remaining intact. The tears which concern us here are mainly those which involve all the coats of the uterine wall, but subperitoneal rents will often present a complication requiring the best surgical treatment to save the case. Rupture in the vast majority of cases starts in the lower segment of the uterus, and extends thence transversely, obliquely, or upward as accident favors. With transverse presentations it generally extends from below upward, starting from the region at which the head rests. In other forms of obstructed labor, particularly those due to contraction at the inlet, the extension is transverse or oblique, the edges in these cases being nearly always more or less ragged.

It is a wise precaution to recognize the possibility of this accident in all cases of obstructed labor, and provide against it by some form of artificial delivery. But if this has not been done and the condition is before us, we must determine the extent of the rupture and the position of the child before planning an operation. In this connection it is also well for us to have clearly in mind the conditions which make rupture so dangerous, and which consequently call for our interference. They are shock, hemorrhage, prolapse of the intestine through the rent, with possible strangulation, and, lastly, peritonitis. They relate wholly to the mother, the child being practically out of the question. All of these accidents may be present in complete rupture, but after the incomplete only three are liable to occur, and of these but two are in any manner urgent. They are shock and hemorrhage, peritonitis being a late and by no means certain sequence. It is not always easy to separate the symptoms of hemorrhage and shock, for they may be intermixed or pass inperceptibly one into the other. Still, as shock forbids operation and hemorrhage demands it, we must sharpen our perceptions in the direction of the latter.

As nearly all incomplete ruptures start on the inside of the uterus and stop at the peritoneum, and as the few which begin externally, stopping at the mucous membrane, are less likely to involve important vessels, we may expect the bleeding from this rupture to be within the uterus and to show in the vagina. An exception occurs, however, where the lower lateral or anterior segment of the uterus is involved, as, for instance, in the tears accompanying transverse presentations or resulting from versions or forceps deliveries. In such cases the tear is subperitoneal, and the blood may be forced laterally between the layers of the broad ligament and thence beneath the peritoneum to the iliac and lumbar regions, or anteriorly to the paravesical space, and even beyond, well up on the anterior abdominal wall. In spite of this eccentric course some blood will show within the passages, and, even should it not, a proper examination would reveal the true condition. Assuming that some one or more of the recognized causes have been at work, the symptoms of shock and hemorrhage should fix our attention at once upon the accident in question. After free stimulation has been instituted and direct transfusion of the normal saline solution provided for, a careful bimanual examination should be made. If the outlines of the uterus are symmetrical, if the presenting part remains as before, and if after dislodging this part upward we fail to get bleeding, our duty consists in combating shock and waiting further developments. If, on the contrary, we get recession of the presenting part, and have bleeding and perhaps a loss of uterine symmetry above the pelvis, rupture may be assumed. Could we at once resort to version, our task might be simplified, but the risk of adding to the rent forbids this measure. If the condition will permit the presenting part to be drawn into the lower pelvis, delivery by some one of the traction instruments, with or without embryotomy, should be accomplished as speedily as possible. If the subsequent contractions of the uterus do not stop the hemorrhage, we should endeavor to reach the bleeding point with a suture, ligature, or clamp, and, failing in this, plug the rent with sterilized cotton tampons, holding them in place by a uterine and vaginal tamponade of sterilized gauze. This line of treatment should be followed, no matter how the rupture has been produced. The after-treatment of these cases relates to the possibility of septic infection of the wound. This is not likely to occur if we are clean in our work and if we provide adequate vaginal drainage for any subperitoneal accumulation which may have sprung from the rupture.

Complete rupture is a far more serious accident, because we have added to shock and hemorrhage the certain danger of peritonitis. It is true this may remain a local affair, but in by far the larger number of cases it becomes general because it is septic. Complete rupture is fortunately not difficult to recognize, because in addition to the shock and hemorrhage we have recession of the presenting part and loss of symmetry by the uterine ovoid. Instead of the rounded outline of this ovoid, we may detect the fœtus outside of the uterus, which may then be felt in a state of contraction entirely within the hypogastric region. In all of these cases, incomplete as well as complete, the immediate effect of the rupture is arrest of uterine contraction. It may return, however, and, continuing, complete what at first was a small rent, and, as has been suggested, end by forcing the fœtus in part or wholly through the rent

into the peritoneal cavity. Complete rupture is then a more complicated and dangerous condition than the lesser rent, and our course is dependent largely upon the position of the fœtus: it is also governed by the condition of the uterus, the state of the patient at the time of rupture, and the extent of the injury produced. If the fœtus be mainly within the uterus, it should be delivered through the vagina, the delivery being made by the forceps or by other traction instrument or by embryotomy as the conditions demand. This presupposes, however, as it does also in incomplete rupture, that one has a passage-way sufficiently large to permit delivery by this route. If this be not so, then the case falls within the category of cases requiring delivery by laparotomy.

Having delivered by the vagina, our next step is a careful exploration of the inner uterine wall to locate the rent and determine its condition and extent. One finger (or better two fingers) should be passed through it gently, and a careful examination of the adjacent peritoneal area made. If a coil of intestine be caught in the rent, it should first be replaced, and if then the peritoneal cavity be found free from any considerable accumulation of clotted blood, we may rest content with a gauze drain through the rent into the uterus and out through the vagina. If, however, we have reason to believe that there has been any considerable escape of blood and liquor amnii into this cavity, the abdomen should be opened and the cavity washed out with sterilized water, or, better, sterilized normal salt solution. Having opened the abdomen, an effort should be made to close the rent, and, should hemorrhage be going on, it should be checked by properly applied suture-ligatures. Turning next to cases in which the fœtus has wholly or mainly escaped into the peritoneal cavity, we reach a positive indication for laparotomy. This having been done, the child and the placenta, if the latter structure has escaped along with the child, are removed, blood-clots are cleared out, and the liquor amnii is washed out with the sterilized normal salt solution. If the placenta is mostly or wholly within the uterus, it should be expressed into the vagina and removed below.

Our next concern is with the uterus. We have already said that one's course would be governed by the condition of the uterus and the patient at the time of the rupture and the kind of rupture produced. This statement refers to the period at which the rupture occurs as bearing upon the general state of the patient and the condition of the walls of the uterus. It is evident that early rupture or one preceding the exhaustion of labor, or free from the destructive effects upon the overstretched tissues of the uterus of futile efforts at forced delivery, present conditions which are more favorable to surgical interference than a later state can offer. It is also evident that such ruptures are more likely to give us rents whose edges are favorable to suturing; therefore, having opened the abdomen in these more favorable cases, cleared it out, and washed it, we are at liberty to suture the uterus after the manner of the Cæsarean section, and should have some confidence that a successful result may be obtained. It is a different matter, however, when we come to deal with ragged rents in a uterus bruised by prolonged labor and by efforts at delivery. Apart from the general condition of the woman, which is certain to be bad, the atony of such a uterus is a serious drawback. If the patient could stand the additional shock, it would be far

better to remove the organ entirely, but, seeing that it is rare such a patient can stand extirpation of the uterus, our hope rests in stopping hemorrhage, removing débris, cleansing the peritoneal cavity and uterus, and then providing for the freest drainage possible of the abdominal cavity, the uterus, and the lower genital passage. The uterus, having been cleansed, should be packed with sterilized gauze, the cul-de-sac should be opened, a gauze drain placed therein, and this, together with the uterine gauze, be supplemented by a loose packing of similar material in the vagina, which in turn is in contact with a thick layer of absorbent cotton placed over the vulva. Before placing this latter a soft-rubber retention catheter, such as is used in vaginal hysterectomy, should be placed in the bladder, the catheter being stopped by a clamp, so as to prevent the passage of urine except at stated intervals, two to six hours as the comfort of the patient may require. The abdominal wound should not be closed except in part, an opening being left of sufficient size to employ the abdominal gauze drain after the manner of Mikulicz. This should be placed freely over the rent and the adjacent area and brought out in abundant folds at the abdominal incision. It is evident that rents upon the posterior surface cannot be drained in this fashion, but they can be through the vagina. This should, therefore, be provided for by a free incision through the posterior fornix, as already suggested. Special care should be taken against hemorrhage from this incision, as the entire vaginal wall is in pregnancy quite vascular. To this end the incision can be made with the cautery-knife, and if needed ligatures can be placed.

It is a question whether all these cases of complete rupture should be treated by the open method of drainage or not. The writer believes that they should be, and bases his opinion upon recent reports, as well as upon results obtained in conditions for which he has done laparotomies. The after-management requires the gradual withdrawal of the gauze—that in the uterus at the end of from thirty-six to forty-eight hours, that in the peritoneal cavity at the end of from three to five days. Complications such as sepsis and peritonitis need not be dwelt upon here, for they do not call for a treatment different in any manner from that which they require when developed after labor or after laparotomy for any cause.

Cæsarean Section.—This operation is resorted to in order to remove the fœtus by means of an incision through the anterior abdominal and uterine walls. The only exception to this site for the incision through the uterine wall is met with in post-mortem Cæsarean section, where, the integrity of this wall being of no consequence and rapid delivery being all-important, it is permissible to make the freest possible cut in the uterus: this permits one to lay the organ open by a sweeping incision carried from behind over the fundus well down to the lower anterior region.

The *indications* for the operation are divided into absolute and relative.

The absolute are the following: A contraction of the pelvis so great as to render it impossible to deliver the child by any other operation—symphysiotomy, for instance—even if mutilated as in embryotomy, or if the passage be obstructed to a similar degree by solid benign or malignant growths which cannot be removed without so lacerating the

uterus as to lay open the peritoneal cavity. This latter proviso applies with special force to malignant disease, because of the septic nature of such growths, rendering, as they do in the event of the inevitable rupture, septic peritonitis a certainty. Cæsarean section is also indicated in certain malpositions of the uterus where the cervix is so misplaced as to make it impossible to bring it in proper relation to the presenting part and to the axis of the pelvic canal. This condition of affairs may be met with in incarcerated retrodisplacement of the pregnant uterus and in a form of anterior displacement which results from an operation for retrodisplacement recently popular, known as anterior vaginal fixation. In the first of these deformities the growth of the uterus is chiefly at the expense of the anterior wall, the cervix being forced against the symphysis or even above it; in the latter the growth is mainly at the expense of the posterior wall, the organ being so doubled on itself and the cervix drawn so far back that, like the first, the os is out of the line of uterine action. If the cervix cannot be drawn into position, it is evident that nothing short of rupture or section of the uterus will permit delivery. Death of a pregnant woman with a viable child—that is, the child being alive, death having occurred in any part of the viable period—calls for this operation. It is evident that the child stands a better chance if it can be released before death has actually taken place: impending death is therefore admitted as an indication, but this can only hold good where there is no possibility of doubt as to speedy dissolution, and then only after the consent of the mother, if she is capable of giving consent, has been obtained. In the absence of ability to give consent the husband and those next of kin must decide the question.

Relative Indications.—The marvellous reduction of the mortality of this operation, standing now as it does at about 10 per cent. for the mothers, with a saving of from 90 to 95 per cent. of the children, has influenced the relative indications very greatly, so that cases which were formerly relegated to the field of embryotomy can now be considered fit for section. These indications really take into consideration the fate of the child and lean to the possibility of saving it without sacrificing the mother. It is presumed that the time for the induction of premature labor has passed, that symphysiotomy can offer no hope, and that the question lies between embryotomy and section. The operation is really one of election, in which the chances pro and con. are to be clearly explained to the parties chiefly interested.

The operation having been accepted either as a necessity or as one of election, the question will then arise as to which of the two operations shall be selected, the true Cæsarean section or extirpation of the uterus.

Section is indicated when the condition of the patient is good, the uterus free from septic infection and not in a state of inertia. Extirpation is indicated when the uterus is infected, if there is partial or complete insurmountable obstruction of the parturient canal by tumors, in osteomalacia (because of the favorable effect of removal upon this disease), in complete inertia, and, lastly, in cases of cancer, provided the disease be so limited as to permit complete removal of the infected tissue.

It is a question whether the uterus should be left in cases of deformity, therefore chancing a second operation in case of a subsequent preg-

nancy. Removal of the appendages would meet this objection, but, after all, it is a question to be decided by the patient.

Preparation.—It is clear from the nature of the indications that one cannot always select either the time, the place, or the condition (of the patient) most favorable to a successful issue. We must face not infrequently unhealthful surroundings, the hour of midnight with insufficient appliances for artificial light, and, a far worse factor, an exhausted state of the mother. But in consequence of a better and more widely diffused knowledge pregnant women are now more carefully watched than formerly, so that in the large majority of cases ample foreknowledge is had of abnormal conditions: as a result, we have an opportunity to forestall unfavorable conditions and can select our own time and place to operate. We should permit the pregnancy to continue until the premonitions of labor appear, and, as these always show themselves from two to ten days before actual labor, we have ample time for that kind of preparation which is essential to any section invading the peritoneal cavity.

The cheerfulness of the patient should be sedulously studied. The bowels should be kept regular and the day before the operation thoroughly moved. Two or three hours before the operation a simple enema may be given, thus leaving the rectum free for such nutrient or stimulating enemata as may be needed. If the urine be scanty, the patient should be encouraged to drink freely of the lighter table waters. By adopting this course two weeks or ten days before the operation the kidneys receive a gentle but efficient stimulus which will last throughout the operation period. It is assumed that the woman lives upon a simple and rational diet, so that no special restrictions are needed till within twelve hours of the operation. A light meal can be taken then, and another six hours later; after that no food must be permitted. The night before the operation the vulva should be shaved, and, together with the entire abdomen and groins, should be freely lubricated and rubbed down with equal parts of water and tincture of green soap. A moistened compress is then fixed over this entire region. Meanwhile the preparation of instruments and other paraphernalia is going on under the direction of competent assistants. In this way, when the hour of operation comes, a plentiful supply of towels (two dozen), gauze mops or sponges, thirty yards of gauze, and at least six gallons of water (each and every article carefully sterilized) will be at hand. The necessary instruments, sutures, and ligatures, sterilized with equal care, will also be ready. These should comprise the following articles: Scissors, two pairs, one pair curved on the edge; scalpels, two; hæmostatic forceps, twelve; needles, twelve, six large and six small, those designed for suturing the uterine wall being half curved, round-bodied, and without a cutting edge or point; two needle-holders; about a yard of elastic cord or tubing; and a large fountain syringe for irrigation. In addition to the foregoing sterilized articles the following should also be provided: a hypodermic syringe, fluid extract of ergot, a thermo-cautery, and ether or chloroform. Four assistants and an experienced nurse are required. One assistant gives the anæsthetic, two aid in the operation as needed, one supplementing the operator throughout, the other handing the instruments, ligatures, and sutures and aiding in the operation

as occasion demands. The fourth stands ready to receive the child and give it his immediate and undivided attention. The nurse provides water for washing out the gauze pads or sponges, and fulfils such duties as may be needed to supplement the more important work of the operator and his assistants. The patient being anæsthetized, the first assistant washes and scrubs the whole abdominal surface and groins with water and green soap. The soap is removed by water and bichloride-of-mercury solution 1 : 1000, and then 1 : 2000. The inside of the thighs, the external genitals, the vagina, and the cervix are now cleansed in the same manner, a soft brush being employed here. Sterilized towels should now be spread over the chest, the legs, and around the region of the incision, care having been taken previously to warmly cover the chest and extremities.

The Operation.—The abdominal incision is made in the median line or an inch to the right or left as the operator may prefer. Its extent depends upon the plan to be adopted. If the uterus is to be incised, emptied, and sutured *in situ*, the cut should extend from the symphysis to an inch below the umbilicus. If, on the contrary, it be the intention to operate upon the uterus outside the abdominal cavity, the incision must be carried one or two inches above the umbilicus. Under the first plan, as soon as the incision is complete, the rubber tubing is passed over the fundus and drawn into position around the uterus as low down as the broad ligament will permit, care being taken to avoid including the intestine. The ends after being crossed should be handed to the third assistant, whose duty then is to so regulate pressure as to control hemorrhage as the uterus is incised. The first assistant with thumbs and fingers extended now makes pressure above and at the sides of the uterus, so as to force and hold its anterior face against the opening. The operator now selects the junction of the lower and middle third of this anterior surface and makes there his cut, about two inches in length : it should be carried down to the cavity, care being taken to avoid injuring the membranes. The placenta needs less consideration, for such injury as the above cut might inflict would not lead, as with injury to the membranes, to the embarrassment of premature escape of the liquor amnii. The cavity having been reached, the index finger is passed gently upward between wall and membrane as a guide : using the scissors upon this guide, we enlarge this incision upward to a point about on a line with the cornuæ. If we need more room, this can be gained by carrying the cut as low as the middle of the lower third, but not lower, because of the certainty of troublesome bleeding from superficial vessels. The average length of this incision is from four to five inches. As soon as the incision is complete the child must be delivered. Inserting the fingers through the membrane or the placenta or turning aside the latter if this be easier, we seize upon the first extremity we reach, and deliver, care being taken to avoid tearing the two ends of the wound. As soon as delivery is accomplished the fourth assistant clamps the cord, cuts it, and takes charge of the child, attending to the details of its resuscitation if this be needed. It is needless to point out that there is great danger of escape of liquor amnii into the peritoneal cavity in this operation, which constitutes the objection to it, the necessary manipulation making it difficult to work with the patient upon

the side. Still, when the time to open the uterus has come it may be done. Gauze and towels must be packed about the incision, so as to absorb as much as possible, but the surest prevention is the steady, constant pressure upon the abdomen above and at the sides of the uterus, so as to keep the organ closely, firmly, and constantly against that incision. In spite of it all, the risk is a constant one, and in the opinion of the writer outweighs the objection urged against operating with the uterus outside of the abdomen: we therefore, preferring the latter, urge it as the method to be adopted. In a few words, it is as follows: As soon as the abdomen has been sufficiently incised the uterus is forced out of the opening by pressure upon the abdomen above and to the sides of the fundus, but if adherent or malformed it may be necessary to carry a hand into the abdomen and lift it out. In one way or the other, however, the uterus is raised from its bed and brought outside. In order to protect and keep in place the intestines the peritoneum and fascia at the edge of the incision above the uterus are caught and held together by about half a dozen clamps. While the operator is doing this the first assistant covers the back, the sides, and the front of the uterus with a plentiful supply of warm towels, so as not only to preserve its warmth, but prevent access of liquor amnii and blood to the peritoneal cavity. These measures complete, the operator directs the second assistant to stand between the patient's thighs and grasp with both hands the sides and lower segment of the uterus in such a manner as to compress the blood-vessels and control the blood-supply. This is a better resource than the elastic ligature, as it is less likely to do injury and not so likely to cause inertia uteri. The subsequent conduct of the operation is the same as when the uterus is left in place. We can proceed, therefore, to the measures necessary after the child is delivered.

We have said that the fourth assistant charges himself with its care. The operator and his other assistants should then give their attention to the completion of the operation. The placenta, and then all débris, blood-clots, and towels should be removed, placing clean towels behind the uterus and about the incision. The outer surface of the organ should then be sponged off with normal salt solution. Meanwhile the second assistant has released the uterus, which, while being washed, is encouraged by gentle manipulation to firm contraction, this being aided by subcutaneous injections of ergot. The sooner uterine contraction can be induced the better: the writer therefore prefers to have this well initiated before he begins suturing, and to this end he releases the uterine vessels as soon as possible, trusting to normal contraction, aided by direct pressure at the cut edges, to control hemorrhage. Of course compression of the vessels must be resumed if these fail.

Uterine Suture.—If Cæsarean section could be treated after the open method—that is, leaving the abdominal incision open, and establishing gauze drainage from the face of the wound in the uterus outward—then the uterine suture would be simpler than it must be with a closed abdominal wound. The wound in the uterus must be so nicely joined that leakage into the abdominal cavity is impossible. If this can be done, the abdominal wound must be closed; if it cannot, this wound must be left open. There is another alternative, however, which, the

patient's condition permitting, the writer prefers: it is removal of the uterus. Presupposing, however, that all things are favorable to the section, the result turns upon the thoroughness with which the wound in the uterus is closed. This is done in the following manner: A row of deep sutures is first placed, and then a row of superficial ones. The first enter and emerge about one-quarter of an inch from the cut edge, running obliquely downward and inward, so as to pass from one face of the cut to the other just above the endometrium, avoiding the cavity of the uterus. (For details see Fig. 307.) These sutures should be half

FIG. 307.

Suture of the uterus.

an inch apart, and should be drawn tightly enough to turn in the peritoneal edges. After all have been carefully tied and cut short the superficial sutures should be passed. (See Fig. 308.) This is the Lembert suture, its purpose being to bring together a strictly peritoneal surface from end to end of the incision. To accomplish this there must be one superficial over each deep suture, and one between—in fact, as many as needed to give an uninterrupted apposition of the peritoneum, not only over the incision, but over the knots of the deep sutures, thus burying the latter completely. The writer prefers silk to other forms of suture, and suggests No. 2 for the deep and No. 4 for the superficial. As soon as this wound has been closed the necessary toilet of the peritoneum must be performed and the abdominal wounds closed. In this connection the writer must say that he prefers and advises irrigation of the lower peritoneal region in all cases in which liquor amnii has reached the peritoneal cavity. Sterilized normal salt solutions must be employed.

It will be noticed that we have said nothing about irrigating or disinfecting the uterine cavity or about hemorrhage from inertia, nor mentioned the need for securing an open cervix. The open cervix is assured any time about the period of natural labor, and if it be not present it can be gotten by dilatation from above or below as seems best; but as for persistent inertia and infection, they are conditions which require removal of the uterus, making it necessary for us to consider, as we now propose to do, removal of the pregnant uterus.

FIG. 308.

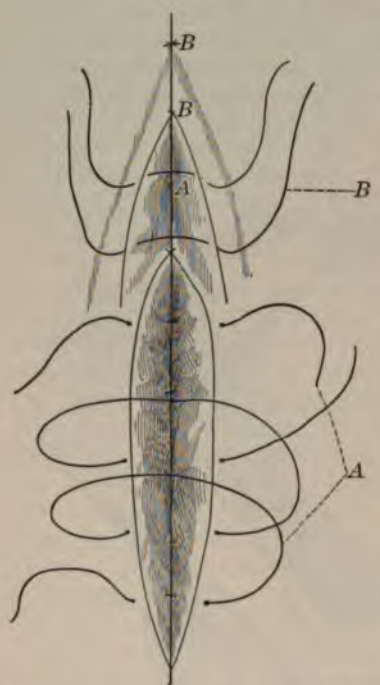


Diagram showing the manner of closing the incision in the uterus: *A*, deep sutures; *B*, superficial sutures.

Hysterectomy.—Porro's name has been given to this procedure, although as presented by him it was a partial, not a complete, hysterectomy. It was, in fact, an application to the pregnant uterus of the principles governing hysterectomy for fibroids by the extraperitoneal method; but along with hysteriotomy in general it has been modified by extension, so that now it can be presented in more than one form, each form best adapted to a special condition. We prefer to treat of it as intra- and extraperitoneal hysterectomy.

Intraperitoneal Operations.—The uterus should be turned out of the abdomen and emptied as described above, the difference in procedure up to this point being the use of an elastic ligature in place of the fingers of an assistant to control hemorrhage. As soon as the child is delivered this ligature should be tied tightly, thus stopping all hemorrhage from the wound. The next step is removal of the uterus. (See Fig. 309.) First tie off the ovarian vessels, then the round ligament, including both in the same ligature if one prefers. Then open the broad ligament beneath the stump thus formed at the edge of the pelvis. Pass two fingers through this opening down alongside of the pelvic wall and find the uterine artery. This is readily done by locating the bifurcation of the common iliac artery; then by running along the internal iliac we quickly reach its anterior, or, speaking more properly, its internal branch, from which (see Fig. 310) the uterine artery turns inward to run between the folds and the lower part of the broad ligament to its distribution at the sides of the uterus. The vessel hangs loosely from the wall, and can be felt at all times by merely grasping the lower and outer segment of the broad ligament between the thumb and forefinger. Having located the vessel where it leaves the anterior branch, we isolate and tie it there. In this region the vessel lies amid loose connective tissue, and can, not only be easily found, but easily isolated—more easily,

in fact, than at any other part of its course. The above statements refer to the vessel in the pregnant state, and at term in a contracted pelvis they apply with fourfold force. After tying both uterine arteries we ligate the utero-sacral ligaments close to the vagina. Then we enucleate the lower fourth of the uterus from its peritoneal covering as far as these ligatures behind and the utero-vesical fold in front: here we ampu-

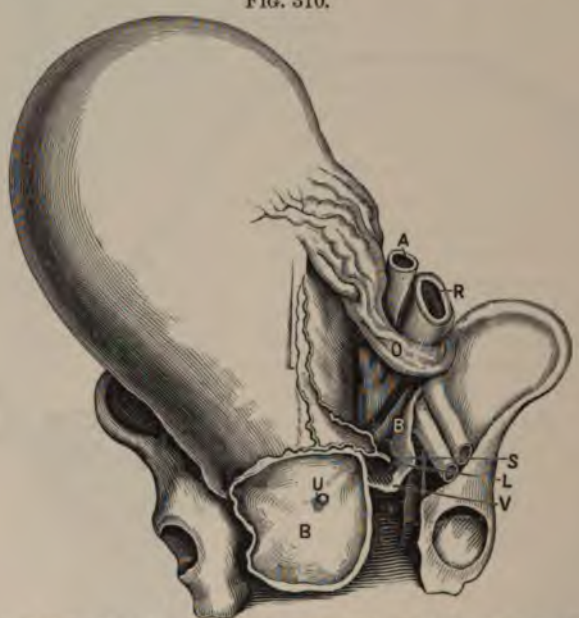
FIG. 309.

Pregnant uterus: broad ligament ligated and cut away, showing uterine artery and ureter.

tate. The cuff of peritoneum removed from the uterus is now turned into the vagina, and the cut edges of the broad ligament, including the stump of the ovarian vessel and that of the round ligament, are permitted to fall into their natural position. A strip of gauze is carried from the cul-de-sac out through the vagina for drainage. The peritoneal toilet, as above stated, is made and the abdominal wound is closed. In order to keep the vagina as clean as possible a retention catheter is

introduced and the dressings are applied, thus closing the operation. It will be noticed that the manner of securing the uterine artery differs from that usually taken, the writer having heretofore tied it inside of the ureter close to the uterus.[1] Another plan of operation is the following: The ovarian vessels are ligated as in the complete operation;

FIG. 310.



Section showing relation of lower part of uterus, when enlarged, to bladder, *B*, to ureter, and vessels. Study in connection with complete hysterectomy in fibroids and pregnancy: *A*, aorta; *R*, rectum; *O*, ovarian vessels; *B*, internal iliac artery growing off anterior trunk, from which uterus springs; *S*, point of ligation; *L*, uterine artery; *V*, superior vesical artery; *U*, ureter.

then the uterine vessels are ligated *en masse* at the sides of the uterus, low down, about opposite the vaginal junction. The uterus is then cut off about opposite the internal os and the stump is inverted into the vagina. This presupposes that the cervical canal is or can be dilated sufficiently to permit the inversion. Working now from the direction of the vagina, bleeding points upon the stump are ligated or clamped. These steps are quite easy, owing to the ease with which the remnant of the uterus can be brought down to the vulva. After the usual toilet of the peritoneum the abdominal incision is closed and dressed; the vagina is then packed with sterilized gauze, after which a retention catheter is introduced. This closes the operation. The vaginal dressing is removed, together with a catheter, after forty-eight hours, and from that time on until convalescence is complete a disinfecting vaginal douche is given night and morning. The stump after passing through its involution recedes within the circle of the external os, and the cervix remains about as one sees it after the usual supravaginal hysterectomy, and it has the superiority of securing a more bloodless field after amputation of the uterus.

[1] The isolation of the vessel before ligating precludes injury to the ureter.

Extraperitoneal.—This should only be performed when the condition of the patient demands haste and when the operator is not an expert. The uterus is drawn upward; the elastic ligature is forced down outside the broad ligament to a point at which the stump which is to be made can rest in the abdominal incision with the least possible tension compatible with the removal of the uterine body: it is then drawn tight, and, after being well tied, its ends are caught in a hæmostatic forceps, which is to be left in place resting upon the dressing to be subsequently applied; transfixion-pins are then passed above this ligature through the ends of the ovarian vessels from side to side, crossing each other in the substance of the stump, each running obliquely from above downward. The uterus is then cut away about half an inch above the pins; the stump is then held up by an assistant and is fixed in the lower angle of the abdominal wall, the pins resting upon the surface upon either side. The operation is then completed after the manner of the same operation for fibroids.

It is evident that convalescence from such procedure is more tedious than one free from the necessities of such a stump as must prevail here.

In all forms of Cæsarean section the treatment subsequent to operation is the same as that needed in other forms of abdominal section for uterine disorders, an exception lying in the case of the stump operation; but here it is the same as that which pertains to the extraperitoneal operation for fibroids. We will therefore refer the reader to the article on Fibroids for further information.

DISEASES OF THE WALL OF THE UTERUS.—The walls of the uterus may become diseased as a result of inflammation or of tubercular disease in consequence of the development within them of benign growths springing chiefly from the fibrous elements of the organ or principally from its muscular elements, and also as the result of the development upon them of some one of the varieties of malignant disease.

Inflammation.—The diseases of inflammation are fortunately the more common, seeing that they are amenable to a treatment which does not compel the sacrifice of the organ. There are exceptions to this statement, however, and to them we will first give attention. The first is chronic hypertrophic, the second is acute puerperal or septic, and the third is tubercular endometritis and metritis. It is true that the present attitude of operators toward the uterus in cases which demand the removal of both sets of appendages is such that many of them remove it along with the appendages, but this step is taken not so much because the uterus itself is diseased, but because, deprived of its appendages, it may be considered a useless organ, one liable to become an offence to its possessor. This condition, however, does not properly fall within the scope of this article, although it is plain that the removal of the uterus for primary cause, and its removal as a sequence to the loss of its appendages, cannot differ materially in the general plan of operation, for in both cases the same organs are extracted and by much the same steps. Our approach, however, being from the standpoint of the uterus, we can only consider the question under the three heads already indicated.

Chronic hypertrophic endometritis and metritis can be cured in the majority of cases by curettage and depletion by gauze packing. But cases occur about the menopause which are so rebellious that they evi-

dently tend toward malignant degeneration. From the standpoint of pathological anatomy we find the following condition prevailing in such cases: The uterus is enlarged, harder than normal, and prone to hemorrhage; its walls show marked increase in the connective-tissue element. The connective-tissue formation is most marked about the vessels, and the hardening of the structure is due less to cicatricial contraction of the connective tissue than to an actual increase in its volume. The most important change, however, is in the lining membrane. This is thickened, and presents villous projections over a part of or perhaps the entire surface. The interglandular tissue in some places has undergone cicatricial transformation, compressing the glands, and by closing the outlets converting some into cysts. The most striking change, however, is the development of new gland-tissue: many of the glands are distorted and present lateral diverticula. There is great increase in the number and size of the vessels, which accounts for the predisposition to hemorrhage. The fact that there is an actual increase of gland-tissue prevents some from accepting this condition as having origin from inflammation, classing it, on the contrary, as a neoplasm and ranking it as an adenoma. One essential clinical fact is evident, however, and that is, its tendency to reproduce itself and thus return again and again after curettage. Summing up the clinical evidences of this condition, we find them to be menorrhagia, an enlarged uterus, and a deterioration of the general health consequent upon the excessive loss of blood. The disease seems to prefer the period about the menopause, but it may develop at an earlier date. The scrapings from the uterine cavity are composed of fungoid structure, showing an actual increase of the utricular glands. It is easy to believe that such a structure may be converted into a sarcoma, and, even though the microscope may fail to prove it, the best opinion inclines to the removal of the uterus after three or four curettings have failed to stop the hemorrhage. In view of the possibility of malignant transformation it is urgent that the scrapings should be carefully examined by an experienced microscopist after each curettage: in this way the removal of the uterus will be delayed as little as possible. Having a case of this kind to deal with, vaginal hysterectomy is the proper remedy.

Puerperal Endometritis and Metritis.—This disease is characterized by a septic infection of the structures of the uterus. Rich in lymphatics and blood-vessels as a consequence of the development incident to pregnancy, the organ favors the rapid evolution of septic changes. These show themselves not only by the quick creation of pus loaded with pyogenic bacteria throughout the entire organ, but by the systemic infection which follows with greater or less promptitude, sometimes with frightful rapidity. If the patient survives the onset of the disease, a process of natural elimination may afford time and opportunity for the localization of the process in the pelvis. In this way pelvic abscesses, having as their bed the tubes, the ovaries, contiguous regions of the peritoneal cavity, or the subperitoneal cellular tissue-spaces, may arise, constituting a condition mainly local. But pus-foci may develop in distant parts, constituting a true pyæmia. The essential clinical manifestations of the disorder are a chill, a fever, and a marked tendency to cardiac weakness. There may be tenderness of the uterus, and some-

times, though not always, a fetid vaginal discharge. These symptoms may run a rapid course, ending in death after five or six days, constituting the condition of sapræmia. As a rule, however, the course is longer, three, four, and as much as twelve, weeks being consumed before a fatal termination occurs. Death results from general peritonitis, from pyæmia, from abscess-formation, and, as already said, from general septic intoxication, which may be acute or chronic. It is evident that the surest way to deal with this frightful disease is prompt cleansing of the uterus, with subsequent drainage, the drainage to be kept up as long as the general symptoms refuse to abate. One might suggest that a surer method would be the removal of the infecting focus, the uterus. It would be were the removal attended with less shock, but septic cases never withstand grave operations—a statement abundantly proven by the results in the class of cases under discussion. In speaking of the surgical treatment of this disease a sharp distinction must be drawn between its acute and chronic phases and between its local and general manifestations. As soon as we suspect the disorder the uterus and outer genital passages should be carefully cleansed and drained. This is done by the combined use of the finger and the curette forceps, by irrigation with a 1 : 2000 bichloride-of-mercury solution, and then by the introduction to the uterus and vagina of a loose packing of sterilized gauze, this packing, preceded by irrigation, to be replaced every twelve, twenty-four, or forty-eight hours until the symptoms abate. Should symptoms of peritonitis arise, the uterus having been treated as above, the cul-de-sac should be opened and the ligaments and appendages examined. If pus be found, incise and drain the infected region ; but if not, the source of peritonitis is the uterus. At this stage of the disease we should not attempt removal of the uterus, even though we are convinced that the general system is but little infected. Little or much, what there is of it is enough, when aided by depression from hysterotomy, to kill the patient. Our only resource is to secure as much drainage as possible. Open the abdomen and cul-de-sac, pack gauze about the uterus back and front, carry one end into and through the vagina, bring the other out of the abdominal incision, which must be left open. In other words, get as much outlet as possible for the infecting fluids forming in the uterus. Exceptionally, a patient might withstand hysteriotomy in the face of acute puerperal septic metritis, but it could only be with the minimum of general infection ; and this is a stage of the disease which is quite likely to yield to the milder measures of cleansing and drainage.

Here, as in other septic infections, the time for success in radical operations is before general septic toxæmia, but, unfortunately, the extension of infection involves an operation of such magnitude as in itself to imperil life. The man is fortunate who can put his finger upon the moment dividing local from general infections, for he at least can say, "Minor measures have failed: we have only to decide between extreme surgical measures and purely medical treatment." If the former is accepted, vaginal hysterectomy must be the operation. This can be done more quickly, with less shock, than the abdominal operation, because of the relaxed uterine supports and dilated state of the passage. Clamps, and not ligatures, should be used, time being an all-important element of success.

Tubercular Disease.—It may seem improper to class tubercular endometritis and metritis among inflammatory lesions, but recent opinions lean in that direction in such degree as to warrant the step here. This infection of the organ is so apt to be but a part of a general infection that direct surgical interference beyond mere curettage may be contraindicated, but in view of the fact that the uterus or its appendages may be the primary seat of the disease, something beyond curettage may be called for. The disease is indicated by the persistent muco-purulent discharge from the uterus, and in some cases erosions of the cervix. These erosions—or superficial ulcerations, as they really are—resemble cancerous erosions and excrescences so much that they have frequently been operated upon as such. The body of the uterus, owing to the infiltration of the accompanying process of simple inflammation, is enlarged sooner or later. The tubes are generally implicated, so that they appear as enlarged masses on one or both sides of the uterus. There may be ulcerations of the vagina in the posterior fossa, and perhaps a similar condition on the vulva. All these ulcerated surfaces present a characteristic appearance. They are covered with a purulent secretion; the floor is granular and presents grayish spots; the edges are abrupt, ragged, and irregular. In the absence of cervical, vaginal, or vulval lesions the diagnosis rests upon the state of the uterus and the tubes, but much light is thrown upon the problem when other parts of the body are considered. The presence of tubercular disease elsewhere is corroborating proof, and if this be in the form of peritonitis the proof is almost positive. But, after all, the condition ceases to have a major surgical aspect where infection is in any manner general. If it is to be treated by any of the greater surgical measures, it must be recognized when the disease is confined to the genital tract.

Pathology.—In point of frequency it invades this region in the following order: tubes, uterus, ovaries, vagina, cervix, vulva. We shall consider it only as it appears in the uterus. We find it in the lining membrane of the body, rarely extending thence to the cervix, seeming thus to reciprocate the development in the cervix, which in turn rarely extends to any part of the body. The disease appears first in the endometrium, extending thence to the deeper tissue of the wall. We find it either as a miliary deposit in the endometrium, as an ulcerative process, the ulcers being single or multiple, or as a chronic diffuse tuberculosis (caseous endometritis).

Ulcerative and diffuse forms are later stages of the miliary form, the general appearance of the lesion as a whole coinciding in the main with the result of tuberculosis in other mucous membranes. When the disease comes under clinical observation it has generally reached the step of ulceration, in which case more or less of the endometrium has been destroyed, or it has gone beyond to the diffuse caseous form. This latter is the form commonly met with at autopsy, and it has come to be the one implied when tuberculosis of the uterus is mentioned. Section of such a uterus reveals an abundance of caseous matter in the cavity: removing it from the walls, they are found studded with tubercles in every stage of development and degeneration, from the isolated transparent grayish tubercle to the aggregations in the irregularly shaped ulcerations, the ragged appearance of the lining membrane being in striking contrast to

the smooth, velvet-like aspect of a normal endometrium. Microscopic section of the walls shows the disease tends to deep invasion of this structure, and that by a subsequent process of caseation it may be so weakened as to suggest rupture. It is a singular circumstance that such an extensive process should be in general limited by the internal os, the cervical canal remaining intact; but this canal may be clogged, or perhaps obliterated, by simple inflammation, as after the menopause, causing retention of the uterine secretions and leading to pyometra. When the cervix is involved it seems to be more in connection with a vaginal infection, while, as already said, infection of the uterus is more an associate of a similar condition in the tubes, the corpus being infected from the tube and the cervix from the vagina, the inside of the corpus and the outside of the cervix being the respective seats of initial developments in the uterus. Given a case in which the uterus is enlarged and has a persistent purulent discharge, we should curette the endometrium and examine it for tubercle bacillus. If this is found, the diagnosis is made and a plan of treatment can be formulated. If the genital tract below the uterus is free from the disease, we are at liberty to consider radical treatment of the disease in the uterus, and in the appendages should they be involved. This presupposes, as already said, the absence of infection in other parts of the body.

We have so little confidence in any measure less than removal of the uterus and appendages that we must recommend it in every case whose general state will permit such an operation. If the condition of the patient will not warrant hysterectomy, we must be content with curettage until we can secure enough improvement to withstand the graver operation.

MALIGNANT DISEASE OF THE UTERUS.—I must depart here from the plan laid out for this article, and include in my topic the cervix as well as the body of the uterus. This is made necessary by the circumstance that I am expected to include such diseases as require major operations upon the uterus. While cancer of the cervix is often treated by a simple amputation, yet the larger number of surgeons prefer to remove the whole organ. Cancer of any part of the organ being, then, an indication for complete removal, the disease must be considered in its several bearings upon the uterus. Cancer develops more frequently in the uterus than in other organs of the female, and it is much more common in the cervix than in the body. The period of the menopause (forty to fifty years) is evidently the one in which it occurs with greatest frequency, although it is not uncommon as a development after sixty, or even between twenty and thirty.

Pathology.—Viewed in its grosser aspects, cancer presents itself at the cervix as a more or less exuberant "cauliflower excrescence;" as nodules in the deeper cervical structure situated beneath the lining membrane of the canal, but showing ultimately as ragged, ulcerated excavations surrounded by ulcerated thickened tissue; and, lastly, as an ulceration of the cervical mucous membrane, which is hidden from view by a constricted external os. The vaginal face of the cervix may be smooth, but somewhat paler than normal, the true state of affairs being evident only after opening the cervix, when the excavated cavity with its ragged walls and foul contents reveals the condition only too plainly. The

cauliflower excrescence is the most impressive of all, for here we have an active, and perhaps an extensive, malignant growth which, involving all the vaginal cervix as a base, may fill the entire upper two-thirds of the vagina. These cervical developments speedily tend to implication of neighboring structures and viscera. The lymphatic glands are involved at an early period, and these may be felt in the broad ligaments, and in thin subjects at the sides and back of the upper part of the pelvic wall. The upper part of the vagina does not long escape infection, and soon the bladder, and finally the rectum, become involved. The endometrium does not escape infection: it is always inflamed, and oftentimes infected by the upward extension of the disease: this pertains particularly to the form of the disease which begins in the lining membrane of the cervical cavity. As the disease progresses, no matter which form may have first appeared, the later conditions in the pelvis are much the same. Masses develop in the broad ligaments, and extend even as far as the pelvic wall; the cul-de-sac may be filled with the growth and its accompanying inflammatory exudate. The nerves and the larger vessels are compressed; the ureters suffer the same fate, become dilated above the obstruction, even as far as the kidneys, which in turn may present single or double hydronephrosis. Destruction of the vaginal aspect of the bladder, and sometimes of the anterior wall of the rectum, causes vesico- or rectovaginal fistulæ, and should a coil of intestine be in contact with any of this diseased area, it may become infected and develop a constriction and even perforation. This rapid growth naturally calls for a decided increase in the size and extension of the vessels, and these in turn, falling victim to the inevitable necrotic process in the affected area, furnish the hemorrhages so characteristic of cancer of the cervix in its later stages. Cancer of the corpus, though not rare, is far less common than cancer of the cervix. This is accounted for by the greater exposure of the latter to the accepted causes of the complaint. The gross appearances vary in the early stages of malignant disease of the body according to the nature of the process. For instance, it may be developed with much the same appearances as a villous hypertrophy of the endometrium, as a circumscribed tumor like a soft fibroid (Fig. 311), and, like a fibroid, be either submucous, intramural, or subperitoneal, or as a diffused thickening of the submucous tissue involving the mucous membrane and spreading more or less through the subjacent wall of the uterus, to finally appear as a distinct tumor on the outer face of the uterus; or it may appear as a pedunculated growth, resembling in appearance a simple polypus. This last formation is classed as an epithelioma, while the others belong to sarcoma, the form of malignant disease more common to the corpus than to the cervix; but the diffuse form of infiltration mentioned above contains, as a rule, epithelial cells, and can therefore readily suffer conversion into carcinoma. The sarcomatous tissue grows rapidly, is full of dilated thin-walled capillaries, quickly reproduces itself, and bleeds readily. Cysts may be developed, giving us cysto-sarcoma, or, where there is a preponderance of the intercellular amorphous substance containing mucin, we have a mass with gelatinous consistency which is called myxo-sarcoma or colloid cancer. Malignant disease of the corpus does not tend so much to implication of the bladder and rectum as that of the cervix, for it

advances rather in the direction of the peritoneal cavity, involving the intestines and appendages, and, if it be sarcoma, infecting distant organs through the medium of the vessels. There is a variety of sarcoma which, developing within the uterus soon after abortion and labor, is considered by some as having origin in decidual tissue: be this as it may, its clinical behavior differs so little from that of the common forms of sarcoma that we may without committing a grave error consider it as one and the same. The contention that decidual tissue can be converted into a malignant growth makes it most important that metro- or menorrhagias persisting after the normal period of involution should be viewed with sharp suspicion. The curette should be called into play early, as well for the cure of the case if it be benign as for its early recognition with a view to hysterectomy if it be malignant. Sarcoma does appear at times

FIG. 311.

Fibro-sarcoma of uterus.

in the cervix, but carcinoma is the common form of malignancy here. It appears mainly in the following forms and in the following order: adenoid, medullary, scirrhous, dermoid. The two latter are rare, dermoid being the rarest of all. Adenoid is the common form, and it eventually changes into the medullary type, but all of them may assume this type, which, as is well known, is the most virulent form of malignant disease. The histological peculiarities of these various forms of malignant disease should next be considered, for upon the knowledge of their minute anatomy depends our ability to differentiate them from benign growths; but space is of consequence in such a work as this, and needless repetitions should be avoided. We therefore refer the reader to the article which treats of tumors in general, reminding him that its general anatomical characteristics are the same for the entire body, the differences being due

to the histological peculiarities of the structure invaded. This must affect the picture presented under the microscope, but knowledge that the specimen comes from a special organ suffices to account for such peculiar anatomical elements and arrangements as may characterize it. We must ask indulgence, however, for one variety of malignant development, and it is that which supersedes, or is claimed to supersede, the benign adenomatous proliferations seen in connection with endometritis, and which we have already considered as a part of some cases of chronic metritis and endometritis. The condition is confounded with fungous endometritis, so called, in which the soft villous projections upon the endometrium mentioned already predominate. It can be differentiated by the microscope, however, which will show in the one (fungous endometritis) increase in the vascular tissue, in the amount of connective-tissue element, enlargements, distortion, and perhaps atrophy of the individual utricular glands, with here and there a gland converted into a cyst. In the other (fungous endometritis adenoma) an increase in the lymph-corpuscles—but more particularly a pronounced increase in the number of the utricular glands, new glandular formation. It is this latter characteristic which accounts for the measurably obstinate nature of the complaint, for it tends to reproduce itself again and again, and will in time implicate the entire endometrium. It is evident such a pathological process is sufficiently akin to a malignant process to be a source of anxiety, and whether one can recognize (as it is claimed can be done not infrequently) the beginnings of scarcomatous change in the epithelial lining of the glands or not (the change being a substitution of round cells for the normal epithelium), failure to arrest the menorrhagia by curettage, and, if need be, by caustic applications to the endometrium, should be followed by hysterectomy.

The **causes** of malignant disease are as obscure here as elsewhere. Injuries from parturition no doubt exercise an influence, but this can be no more than predisposing, as there are too many cases developed in unmarried women and virgins to consider those injuries as an ultimate cause.

The **clinical evidences** of malignant disease differ as they spring from the cervix or the corpus.

The **symptoms** of the disease at the cervix appear after the signs can be demonstrated: for this reason women rarely realize that they are ill until the initial stage has been passed and that of ulceration reached. The first symptom is a watery leucorrhœa, which becomes fetid sooner or later in proportion to the exuberance of the growth and the rapidity of the ulceration. The next is hemorrhage, first menorrhagia, and then metrorrhagia; then deterioration of the general health from anæmia, from cancerous and from septic infection. Symptoms of cystitis appear as the bladder is involved and if the rectum suffers constipation, and later bloody and purulent stools appear. If vesico- and recto-vaginal openings develop, urine and fæces come from the vagina, all mixed with the foulest discharge from the cancerous surfaces. The late manifestations of cancer of the cervix can be recognized by any one, and are already named as a part of the gross pathology of the condition. The early change is the important one, for it is the only one susceptible of cure. It shows itself by a hard exfoliating red surface, not unlike that

seen in eversion of the cervical canal after the laceration of labor; or there may be no raw surface, but instead induration of the deeper cervical structure—a hard, cartilaginous state of the walls of the cervical canal.

FIG. 312.

FIG. 313.

Forceps for morcellation.

Any condition of the cervix which approximates the above appearances demands removal of a piece of the affected area large enough to permit a complete miscroscopical examination.

FIG. 314.

FIG. 315.

Blunt-toothed volsella.

This will determine the diagnosis. If it be cancer, the entire uterus should be removed; removal of the cervix is not sufficient.

The **symptoms** of malignant disease of the corpus are at first not unlike those present in chronic metritis and endometritis; that is, we have menorrhagia, leucorrhœa, backache, and a sense of over-fulness in the pelvis. But the leucorrhœa is watery, is ichorous, is finally fetid; the menorrhagia becomes metrorrhagia; abdominal pain occurs, due to

FIG. 316.

Clamp with smooth fenestra for drawing down appendages in vaginal hysterectomy.

the implication of the peritoneum: all these, together with a marked growth of the uterus and the appearance upon it or about it of nodular masses, make the diagnosis easy.

If it be still obscure, a microscopic examination of scrapings from the uterus will tell the true condition. The usual symptoms of general cachexia soon appear, and not infrequently ascites is added. In sarcoma

FIG. 317.

FIG. 318.

Clamps.

of the endometrium we have a quickly-growing vascular tumor, which under the pressure from the resisting uterine wall undergoes necrosis in its lower portion, giving a friable fetid mass which bleeds readily and quickly leads to general septic infection. It grows rapidly, reappearing in a few weeks after removal. Formerly called recurrent fibroid, it is now known as a malignant variety of sarcoma.

Early recognition of the disease in the corpus is as essential as elsewhere. This is only possible with the aid of the microscope; therefore curette all these cases early and submit the scrapings to an expert microscopist.

Our suggestions so far have been based upon the idea that the disease, whether of cervix or corpus, develops within the period of life given to menstruation; but, as said, it comes after the menopause.

With a woman in whom a leucorrhœa appears, and in whom after the menopause a hemorrhage from the vagina appears, suspect malignant disease, and examine her until you prove or disprove the suspicion. As

FIG. 319.

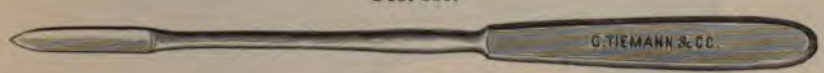
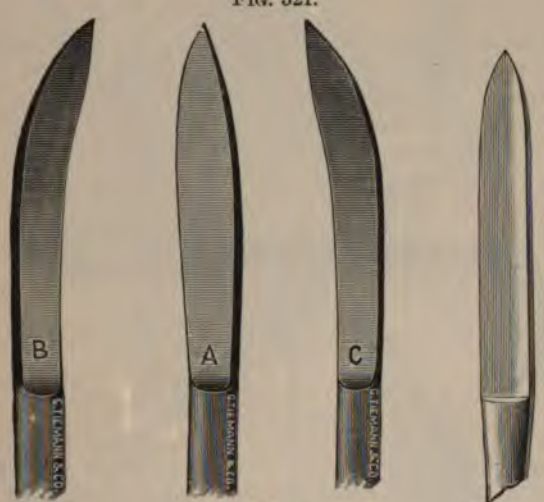


FIG. 320.

FIG. 321.



Knives.

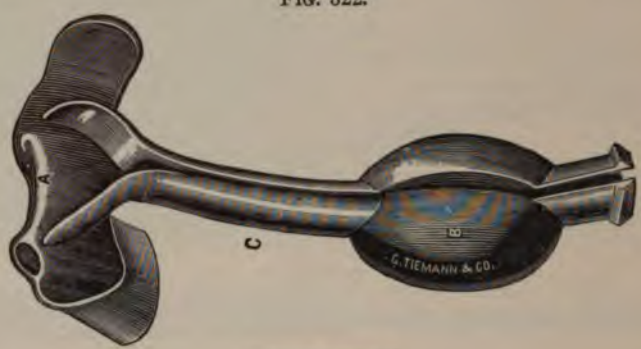
with malignant disease of the cervix, so here, hysterectomy is the proper remedy.

Surgical Treatment.—In treating of the diseases of the uterus we have assumed that all mentioned by us were of such nature as to demand removal of the entire organ. We are therefore at liberty to proceed at once to a description of the forms of hysterectomy appropriate to our subject.

Hysterectomy may be made either by way of the vagina or through the abdominal wall. As the writer is firmly of the opinion that most of the diseased states enumerated are best removed by vaginal section, he will first describe that operation. In this he will venture to encroach upon a companion article; inasmuch as he is compelled to admit a concur-

rent diseased state of the appendages in some of the conditions of which he treats. Where such is the case, the technique of removal extends to the diseased appendages: he must therefore describe the steps of operation requisite to that end. He also feels himself excusable in this because,

FIG. 322.



Perineal retractor.

holding as he does, in common with others, to the opinion that bilateral disease of the appendages calling for their removal warrants the simultaneous removal of the uterus (the condition of the patient permitting), he thinks he has given the writer upon diseases of the appendages an opportunity to freely dwell upon the technique of hysterectomy.

FIG. 323.

Vaginal retractor.

Preparation for Operation.—Until recently the preparation of the patient was almost as elaborate as that deemed essential for the operator, bnt perfection of the latter has simplified the former, so that it is now more in keeping with that necessary in any of the

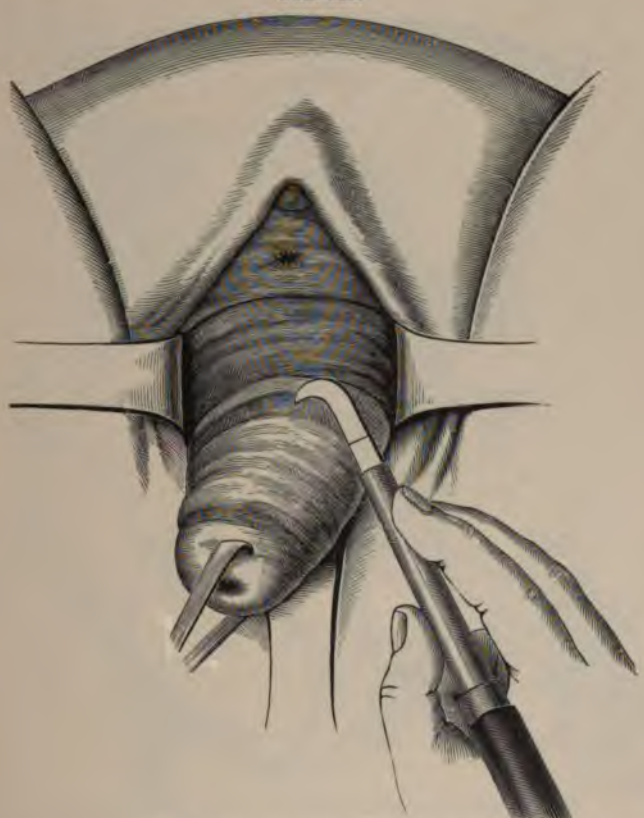
FIG. 324.

Retention catheter.

major operations. We would speak here of the preparations for the operator did we not know that these had received abundant notice in the several descriptions of operations already given: we might also pass by preparations for the patient, were it not that special attention must be

given to the vagina. Every pelvic case in women must be viewed as calling possibly for a combined operation, and therefore all cases must be prepared for abdominal as well as for vaginal section. A vaginal hysterectomy may call for an abdominal incision before it can be finished, and all abdominal hysterectomies (complete) necessitate vaginal section. To this end, therefore, we prepare our patients as follows: Do not starve them, but see that the diet is light and simple for twenty-four hours before operation, and food of no kind should be permitted for at least six hours before operation. The day or night before, the bowels should

FIG. 325.

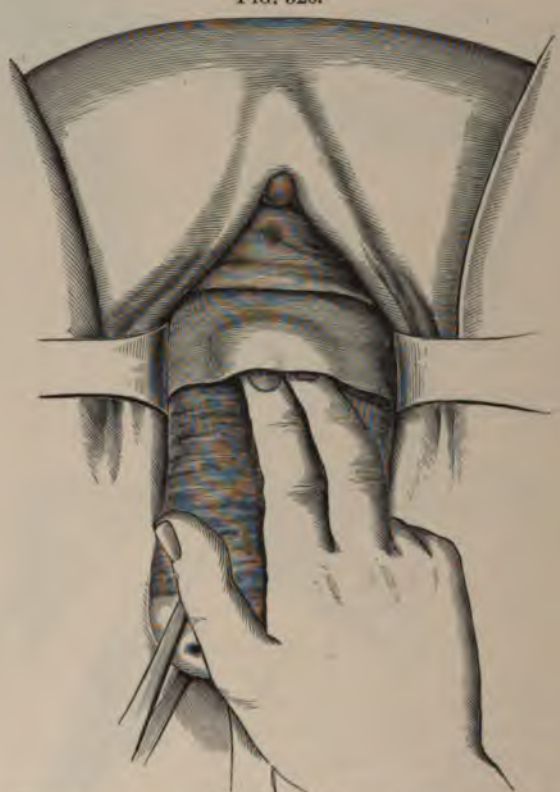


Vaginal hysterectomy, cautery in action.

be emptied by a brisk cathartic, and six or seven hours before operation the lower bowel should be washed out with a copious enema of warm water and soap. The bladder must be emptied by catheter after the patient is upon the table. Some operators prefer to shave the pelvis and rub down the abdomen twelve hours before operating with green soap and water, and then fasten over it a moist pad of cloth: this measure softens the epidermis and makes it easy to clean the surface at the time of operation. The writer's plan is to wait until the patient is anæsthetized and then quickly shave pubis and vulva, soap the entire

surface, abdomen, groin, inner thighs, and vulva, and rub down with a good stiff brush, paying special attention to the folds of the umbilicus. The entire surface is then freely treated to a solution of bichloride of mercury, 1 : 2000, and is then wiped off with 1 : 1000 : this in turn is washed away with sterilized water. Covering the surface with a sterilized cloth, we turn next to the anal region, the perineum, buttocks, and thighs, all of which are cleansed after the fashion of the abdomen. Then our attention is turned finally to the vulva, the clitoris, vestibule, vagina, cervix, and the uterine canal. A brush is also essential to the vagina,

FIG. 326.



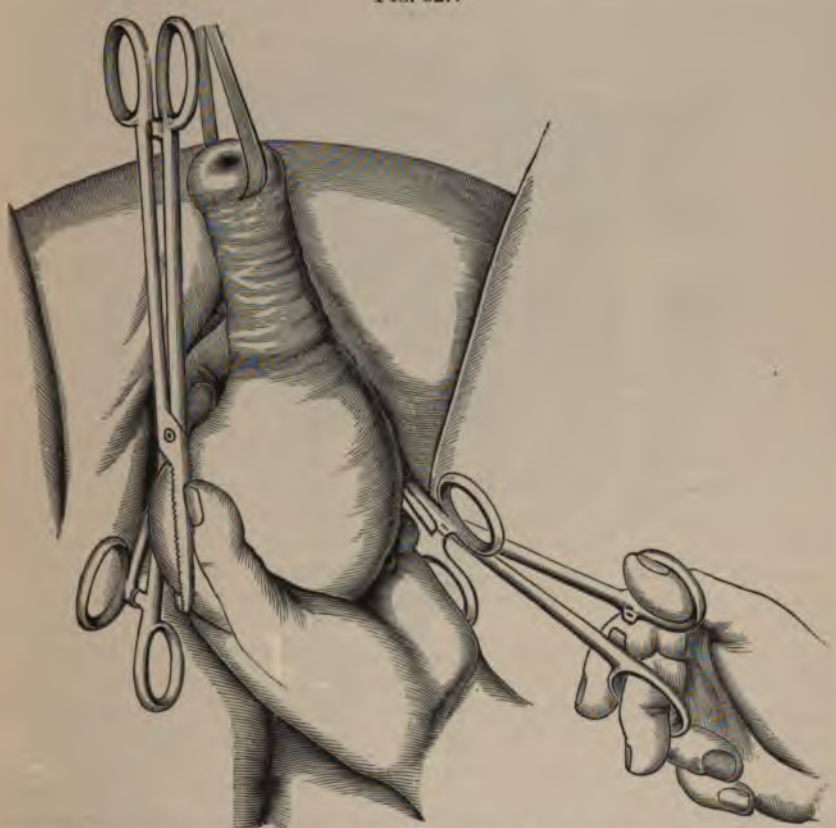
Vaginal hysterectomy, enucleation of lower uterine segment.

especially in the virgin vagina with its rugæ. We wash away the soap and water with the same mercury solution, 1 : 2000, applying after this 1 : 1000, and washing this away in turn with sterilized water. When all this has been carefully done the patient is ready for the incision. As said above, we will first present vaginal section.

Vaginal Hysterectomy, as Applied to Conditions of Inflammation.— A soft-rubber rectal tube to act as a guide to the location of the gut should now be carried into the rectum and passed well up to the sigmoid flexure. The cervix is now grasped back and front with a blunt volsellum, and drawn forcibly down as near the vulva as possible. The

vagina at the utero-vaginal junction is then cut through with the cautery entirely around the cervix (Fig. 325). This accomplished, the enucleation of the cervix is carried on with the index and middle fingers (Fig. 326), until the bladder is separated and the utero-vesical space in front and the cul-de-sac behind have been opened; the vessels at the sides are not molested, the vaginal wall being merely pressed back to give easy access to them for ligatures or clamps. If the case is simple—that is, if there is no extensive matting together of the viscera, as in bad cases

FIG. 327.

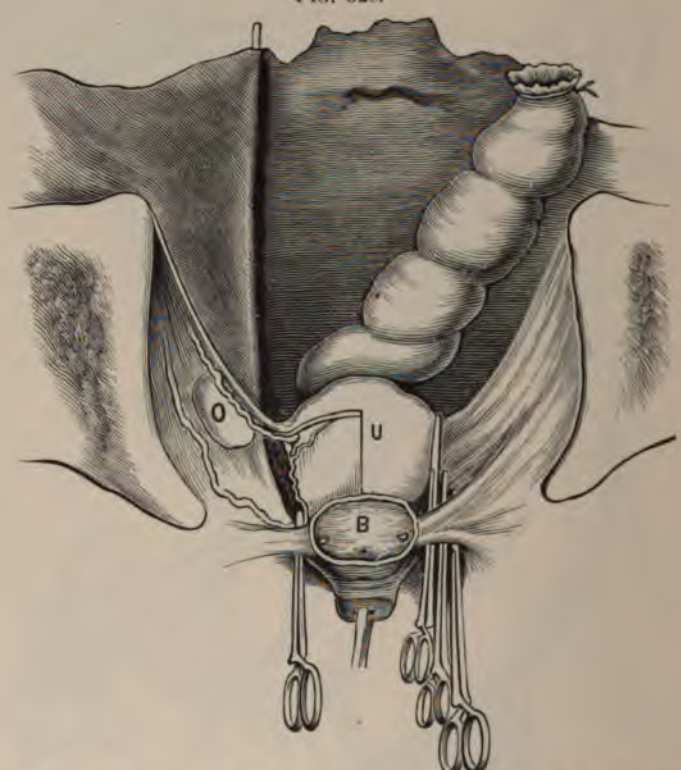


Vaginal hysterectomy, clamps being applied at left cornua, already in place at right cornua and lower connections of the uterus.

of suppurative disease—the peritoneum upon the base of the bladder and in the cul-de-sac should be attached with a single stitch (catgut) to the corresponding vaginal wall. The way is then clear for the application of the clamp or ligature as one may elect. If it be ligature, this is passed first on one side, then upon the other, so as to secure the uterine artery. If, on the contrary, clamps be preferred, one is placed on each side, so as to secure the entire lower half of the attachment of the broad ligament to the uterus, which will include the artery. These clamps are made to hug the uterus as closely as possible, and are guided into posi-

tion by the thumb and index or index and middle fingers, thrust one in front the other behind the broad ligament at the uterine attachment. The vessels of the lower segment of the uterus being secured, the organ is cut free to about its middle: still applying steady traction, the upper attachment of the uterus is brought down; this is clamped (Figs. 327, 328) or ligated, and then the entire uterus is cut out. The succeeding steps depend upon the condition presented. If it be a simple pyo- or hydro-salpinx, these, along with the degenerated ovaries, are enucleated by the fingers aided by long forceps, and are then clamped or ligated at the

FIG. 328.



Vaginal hysterectomy, diagram showing relative position of clamps when in place: *U*, uterus; *B*, bladder; *O*, ovary; *R*, rectum.

attachment to the broad ligament and cut away. If it be an ovarian tumor, this is drawn down to the vagina, is then tapped, and after the contents have been removed the sac is withdrawn, much after the manner which prevails in abdominal section.

The serious difficulties arise in connection with pelvic abscess. We may not be able to remove the uterus as cleanly as has been described, but may be forced to take it out by morcellation, cutting it out segment by segment, clamping the bleeding vessels as they appear. The lower posterior half is first removed, then the anterior. In this proceeding we may open promptly into a pus-sac in the cul-de-sac. After cleansing

this out we proceed to the upper half of the uterus: this should be cut open antero-posteriorly. After removing the two segments we use the cut ends of the cornuæ as guides to the pus-sacs, tubes, and ovaries of either side. Feeling one's way carefully, making traction upon the sacs, first one side, then the other, is drawn down, enucleated, and removed. It may be that this process will have to be done in the depth of the pelvis; if so, one cannot use too much caution, for it is in such cases that visceral injuries are most liable to occur. Patience and intelligent perseverance will enable one to surmount the difficulties, so that it is rare that one will be forced to call to his aid abdominal section. This, however, should be done if the intestine high up in the pelvis has been ruptured. Having opened above the pubis, the patient should be thrown into Trendelenburg's posture and the injured intestine quickly found and repaired. If any sac or parts of sacs remain, they should be cleared out: the pelvis must then be washed out with sterilized water, and a loose gauze drain placed at the bottom, extending thence through the vagina.

After vaginal hysterectomy, it is wise to leave the vaginal cut open, draining through it by a good strip of gauze, which extends from the cul-de-sac to a proper dressing over the vulva. This precaution is optional in clean cases, but it is an absolute necessity in all pus cases. If ligatures have been used, they are left long, tied together, and placed in the vagina.[1] If clamps are employed, they are looked over carefully to see if each is secure, doubtful ones being further guarded by tying the handles firmly together. The handles of the clamps are then encircled with a thick layer of absorbent cotton, which in contact with the vaginal drain furthers its function. A soft-rubber retention catheter is finally placed in the bladder, and the operation may be said to be complete. To realize its object, the catheter must be plugged or clamped at its free end: by removing this at intervals of two or three hours the bladder is properly emptied and the dressings are kept clean. An outer cotton dressing and the catheter are essential to all cases of vaginal drainage.

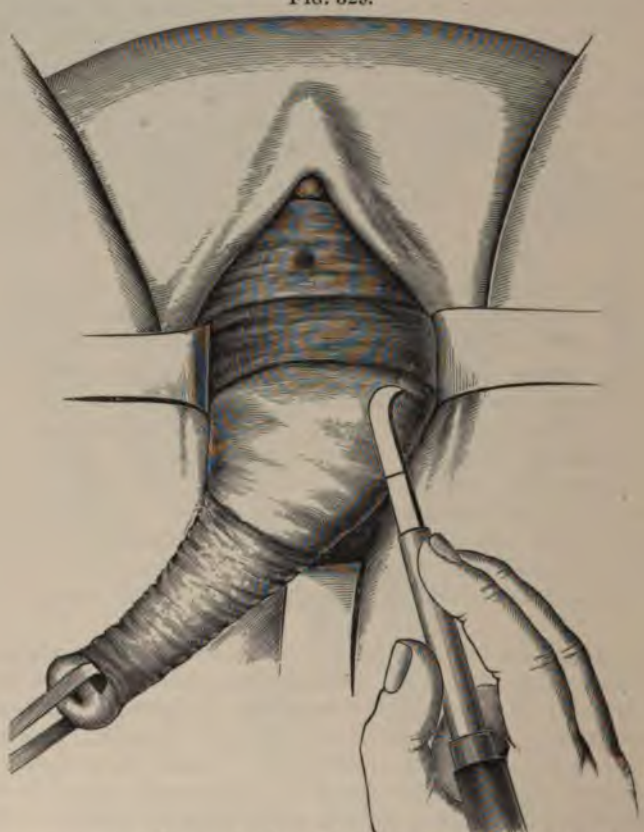
A word must now be said about enucleation without clamps or ligature. It can be done, but it has its limitations, and should be performed with the cautery. We confess, however, that a ligated or clamped vessel makes us less anxious, and, as there is no valid objection which is at all weighty, we prefer to use one or the other. Ideal cases for this operation are women past the menopause or women who have been rid of their appendages, the uterine vessels with all such persons being more or less atrophied. It is done as follows (Fig. 329): Seize the uterus at the cervix, burn through the vagina at the utero-vaginal junction, keep up forceful and continuous traction upon the cervix, at the same time burning through the attachments to the uterus as they descend. This burning must be made close to the true uterine tissue, the cautery being driven firmly into it. It is best after each segment has been burned through to sear each stump of tissue. Proceeding in this man-

[1] Clement Cleveland has devised a platinum loop, which, welded to copper wire, forms a connection for the galvano-cautery. Each ligature when tied includes one of the loops. When the time for removal comes the ligature is cut by the current and withdrawn along with the loop.

ner, the uterus is quickly peeled from its envelope and the cornuæ are brought into view. These are burned through and their stumps are seared. In the removal of the tube and ovary it is wise to use ligatures or clamps. This having been done, the operation is complete. The after-dressing and treatment are the same as in other cases.

Speaking now of vaginal hysterectomy in general, clamps should be removed in from forty-eight to seventy-two hours, after which the patient should receive a night and morning douche of warm disinfecting solution for purposes of cleanliness and comfort. Ten days mark

FIG. 329.



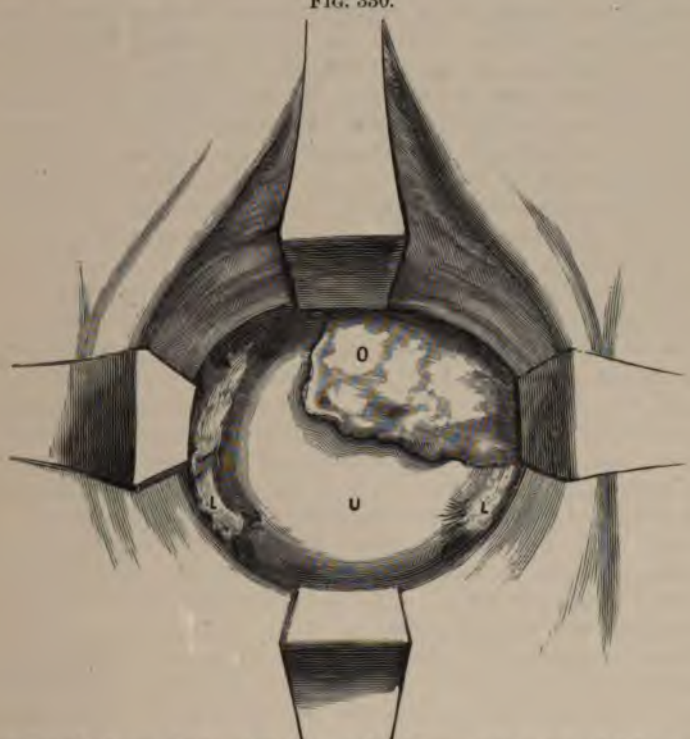
Vaginal hysterectomy: complete enucleation of the uterus with the cautery, without clamps or ligatures.

the usual limit of convalescence in bed, the patient being permitted under ordinary circumstances to take the sitting posture at the end of a week. The catheter should be removed when the clamps are taken off. Ligatures should be cut out at the end of two or three weeks, or in three or four days if Cleveland's appliance is used. The bowels are treated much as in abdominal sections, but there is one comfort the patient can enjoy—that is, morphia for the relief of pain. This drug does not appear to have as troublesome consequences after this form of operation as after abdominal sections.

While it is evident that the scope of this article precludes any extended notice of operations upon the appendages, we feel justified in noticing here two which have a close alliance to vaginal hysterectomy —as close, in fact, as exploratory abdominal section has to completed abdominal operations: we refer to anterior and posterior colpotomy, operations devised for exploration and for certain conservative procedures.

Anterior Colpotomy.—The cervix is caught just below the utero-vaginal junction; strong traction is then made while with the cautery we make a transverse incision from side to side through the anterior

FIG. 330.



Anterior colpotomy; fundus uteri anteverted and drawn into vagina: *O*, left ovary; *U*, fundus uteri; *L*, Fallopian tube.

vaginal wall coincident with the above injunction. If the uterus is small, this incision need go no farther than the sides of the cervix, but if it is large, it should be extended thence downward and outward half an inch or more on to and through the latero-posterior vaginal wall. The bladder is next separated from the uterus: using the index and middle fingers for the purpose, the utero-vesical fossa is entered; sweeping the fingers right and left, the bladder and ureters are pressed well aside. Still using the two fingers, the several viscera, including the uterus, broad ligament, appendages, intestine, and bladder, are carefully palpated, and all adhesions are broken up. Finding conditions favorable to some form of conservative operation upon the uterus or append-

ages, we proceed according to the problem presented. Let us suppose it to be the removal in whole or part of an ovary or tube. Antevert the uterus and bring the fundus and body through the vaginal incision into the canal (Fig. 330). This can be best done by bringing through first one of the cornuæ, after which the remainder of the organ is made to follow. Several instruments have been devised to further this step, which is the most difficult in the operation, but nothing is so good as two fingers of the operator working through the incision. After the organ is drawn well into the vagina we act in accordance with the problem before us. If the ovary is to be operated upon, as in the puncture or enucleation of small cysts, or if it is to be removed, it is drawn through into the vagina, being reduced in size when necessary by aspiration or incisions. When it is in the vagina, it is at the command of the operator, and can be removed in whole or part as need demands. These statements are applicable to the tubes, which should also be brought into the vagina, being previously emptied of fluid contents by aspiration. The ligation and removal of an ovary, which should be done independently of the tube, is in general simpler than the same operation upon the tube, because of the less extended connections. It is drawn well down and ligated by passing the ligature through the base of its attachments. After ligation it is cut away. Dealing with the tube, we proceed as follows: Tie as much of the mesosalpinx as you can; this, generally, is all of it; then ligate the uterine end of the distribution of the ovarian artery by including every structure at the cornua except the tube; hug this closely with your ligature. Next enucleate the tube, cut it off, and tie such bleeding points as appear. Having completed the operation, the uterus is returned to the abdominal cavity, and the divided peritoneum of the utero-vesical fold is reunited with catgut sutures. It may be sometimes necessary to pass from anterior colpotomy to hysterectomy, as when, for instance, we discover that both tubes are purulent and that the ovaries are similarly involved. This can be easily done by carrying the incision around the entire utero-vaginal junction, and then proceeding to the removal of the uterus, as we have already described.

Posterior Colpotomy.—This section is resorted to for purposes of drainage in acute or chronic inflammation involving the cul-de-sac: it is a part of the operation which looks primarily to the evacuation of pus-sacs, pelvic hæmatocele, the removal of cystic ovaries or small ovarian tumors, to explorations of the pelvis, and to the breaking up of adhesions imprisoning the uterus or appendages, as particularly evident in cases of retrodisplaced and adherent uteri, in which latter state it is of inestimable value. The operation consists of a vertical section of the posterior vaginal wall extending from the utero-vaginal junction to the bottom of the cul-de-sac: it may be enlarged by lateral incisions, but more than the usual bleeding must then be expected, the single vertical cut being, as a rule, comparatively free from hemorrhage. It may be made with the cautery, especially if we contemplate the lateral incisions, with the knife, or with the scissors, to be supplemented by ligatures if there is troublesome bleeding. If pus or some such infecting material as the contents of a dermoid cyst be encountered, the incision should be left open, a gauze drain being introduced, but in clean conditions the cut

should be closed with catgut. Whenever the incision into the cul-de-sac is left open, a gauze drain must be used, as after vaginal hysterectomy, and a retention catheter employed.

Vaginal Hysterectomy for Carcinoma.—Carcinoma of the cervix uteri when operated upon has heretofore been treated either by amputation, as described in a companion article of this work, or by vaginal hysterectomy. The details of the latter operation are much the same as already given, but there are some departures to which attention must be drawn. The sloughing and ulcerated surface presented by a cancerous cervix is a source of sepsis to which special attention must be paid. Some operators prefer to divide the operation into two steps. First, amputation of the infected tissue, and then subsequently, at an interval of a week or two according to the state of the patient, perform vaginal hysterectomy. The writer favors this plan in cases where it is evident that a clean surface cannot be gotten primarily. If one can be obtained, however—that is, if all the diseased tissue can be cut away—he prefers to do the entire operation at one sitting. He uses the cautery as heretofore described, but encroaches much more upon the vagina, using special care to avoid injury to the bladder: to this end a sound should be kept in this viscus, and as soon as the vaginal wall has been penetrated in front further enucleation is conducted by the fingers, as already mentioned. As soon as the peritoneum, back and front, has been entered the vessels are secured by clamp or ligature, as in other forms of hysterectomy, and the appendages are removed.

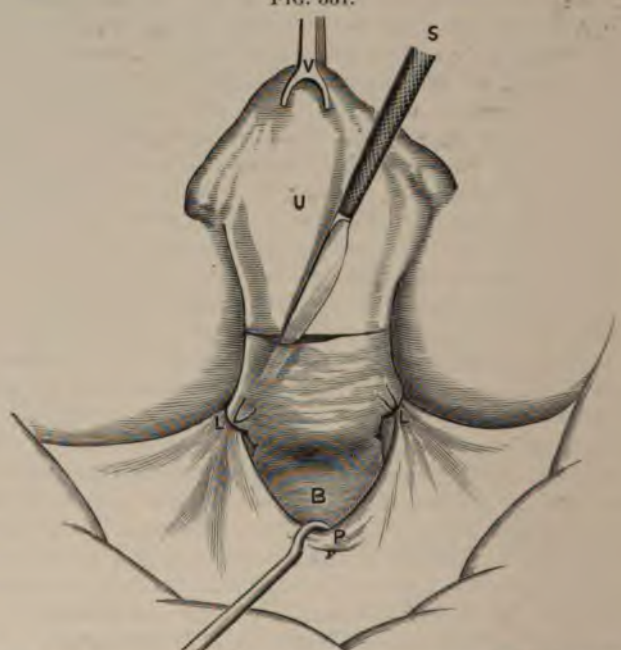
Carcinoma of the corpus can likewise be treated by this operation, but it should be preceded by special curettage and cleansing of the cavity. In spite of the utmost care, infected areas may be left outside of our field of operation in both conditions, for we cannot go far to the right or left in the vaginal approach without serious risk to the ureters. Howard Kelly practises preliminary introductions of catheters to these canals as guides—a valuable aid, and one that should be adopted when practicable. Were the requirements of the operation as simple as with the conditions of inflammation which permit us to cling closely to the uterus, freeing us from urgent care of the bladder and ureters, we might be content to advocate it as the proper operation for cancer of the uterus; but as this is not so, it is permissible to look for some better way of reaching an area which must be excised if the patient is to be cured. The writer believes that this can only be found in abdominal hysterectomy.

Abdominal hysterectomy in carcinoma of the body is the operation which many prefer, but, as said already, the vaginal operation is the one recognized and almost universally performed for carcinoma both of the cervix and corpus. This preference is no doubt due to the mortality of the abdominal operation when first tried, but this was at a time when the technique of peritoneal operations was in its infancy, when all such operations showed a death-rate far above that now presented. It is fair to assume that present methods can give results in immediate mortality commensurate with those obtainable by the vaginal route, and it is evident, other factors being equal, that the obligation to do all that is possible to eradicate the disease warrants us in adopting the best approach to the infected area. With this understanding the writer will

describe abdominal hysterectomy as performed in the non-malignant conditions, and then pass on to the modifications made necessary by carcinoma.

Abdominal Hysterectomy for Conditions of Inflammation.—The incision through the wall should be of sufficient length to permit ready manipulation in the field of operation. As soon as the abdomen is opened a careful digital exploration must be made and the plan of procedure determined. Assuming that the appendages are affected, we enucleate, and when they are infectious remove them first, preceding enucleation by aspiration whenever we fear rupture of any sac containing pus or other contaminating matter. The removal of the appendages

FIG. 331.

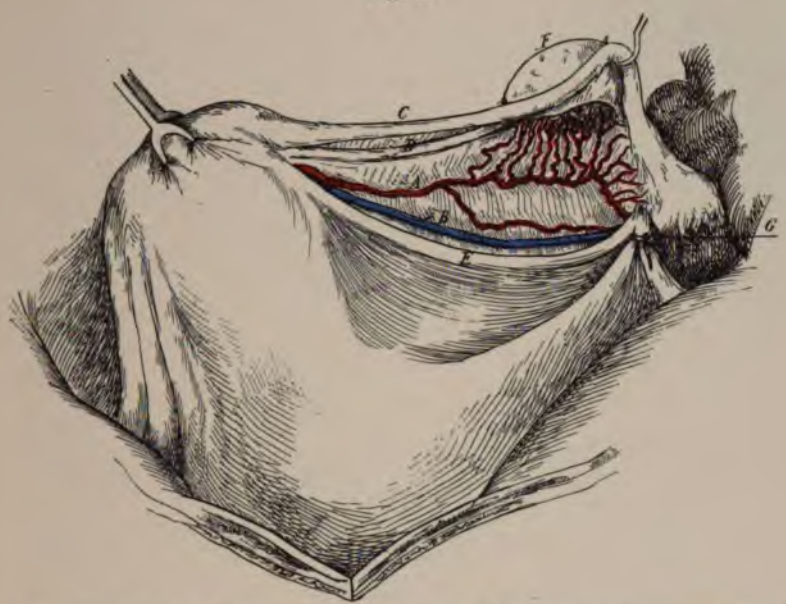


V, volsellum grasping uterus and pulling it upward to facilitate enucleation; *U*, anterior face of the uterus; *S*, scalpel enucleating lower segment of uterus from its external root; *L*, interlocked double ligature securing upper vaginal arteries and uterine artery. Ligature securing uterine artery is above, and is tied above and in front. Ends are left long in the figure to indicate the knot.

should be conducted along the line to be followed in the hysterectomy—viz. we ligate the ovarian vessels and the round ligament *en masse* where they cross the brim of the pelvis (Plate X., Fig. 1); we clamp the structure in the broad ligament at the sides of the uterus *en masse*; we then cut away the infecting structure, taking up and completing the operation upon one side before beginning it on the other. After the removal of the appendages we proceed as in cases uncomplicated by tubal or ovarian disease. Retracing our steps somewhat, we will assume the case to be one of the latter and proceed as follows: Ligate the ovarian vessels and round ligaments at the pelvic brim, and clamp the uterine attachment of the broad ligament as already described; next cut through the tissues

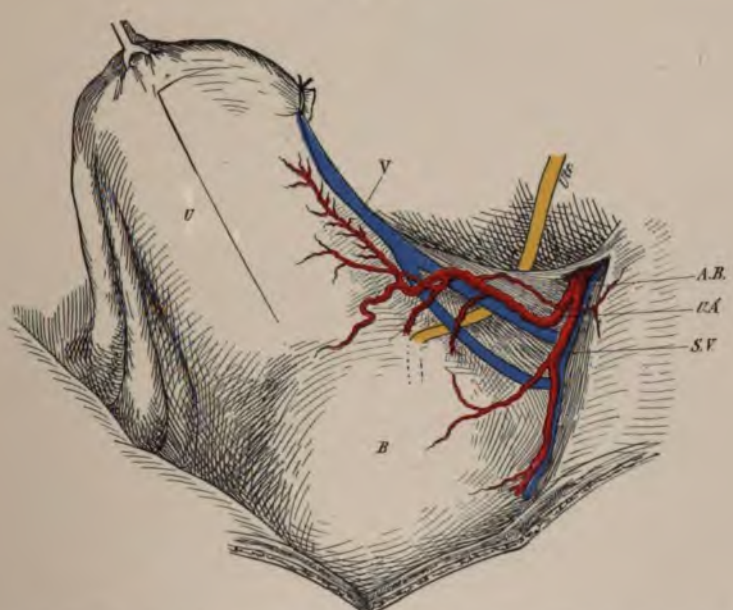
PLATE X.

Fig. 1.



Upper border of broad ligament opened out to show the structures contained therein and their relation to the ligament at the pelvic brim. *A.* Ovarian artery and branches. *B.* Principal vein. *C.* Fallopian tube. *D.* Ovarian ligament. *E.* Round ligament. *F.* Ovarian ligament. *G.* Ligature.

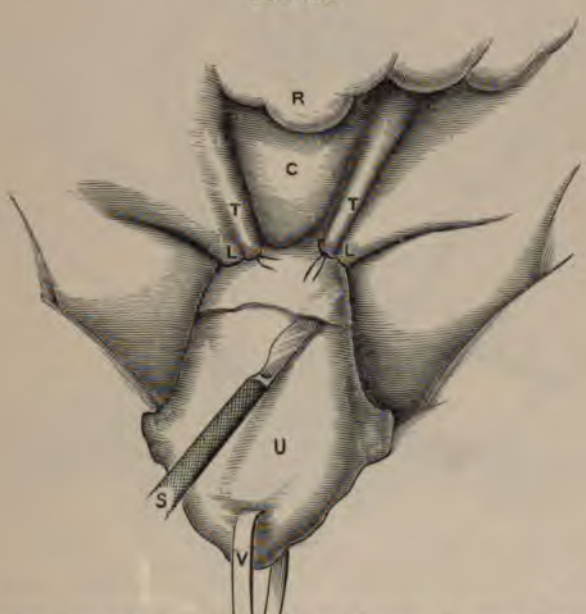
Fig. 2.



Broad ligament and ovarian vessels ligated and cut away preliminary to ligation of uterine artery; exact relation of the artery and its branches, of the principal veins and the ureter, when the uterus is drawn forcibly upwards and sideways to gain space for the ligation of the uterine artery at its origin. *U.* Uterus. *B.* Bladder. *Utr.* Ureter. *A.B.* Anterior branch internal iliac and branches—first, the superior vesical artery, marked *S.V.*, passing along pelvic wall to upper part of bladder; second, the uterine artery, marked *U.A.*, turning inwards to be distributed with its branches to the uterus, the vaginal wall, and the paravesical space, stated in order from without inwards; those branches as given off in this dissection are lateral vaginal, paravesical, anterior vaginal, annular. *V.* Principal vein. The angle in ureter at vagina due to upward traction.

well inside the ligatures, but outside the ovaries and tubes, carrying the incision obliquely downward and inward through the broad ligament to its attachment at the sides of the uterus. Then ligate the tissues about the base of the uterus, first on one side, then upon the other, as follows: Draw the uterus upward and backward, cut through its anterior peritoneal coat on the lower third of the body, and separate the bladder as far as the vagina, carrying the separation around toward the lateral aspect of the uterus, which we hug rather closely, thus imitating the analogous step in vaginal hysterectomy. We thus gather at the sides of the uterus its vascular connections, together with those belonging to the upper part of the vagina, and can ligate them *en masse:* this we now proceed to do.

FIG. 332.

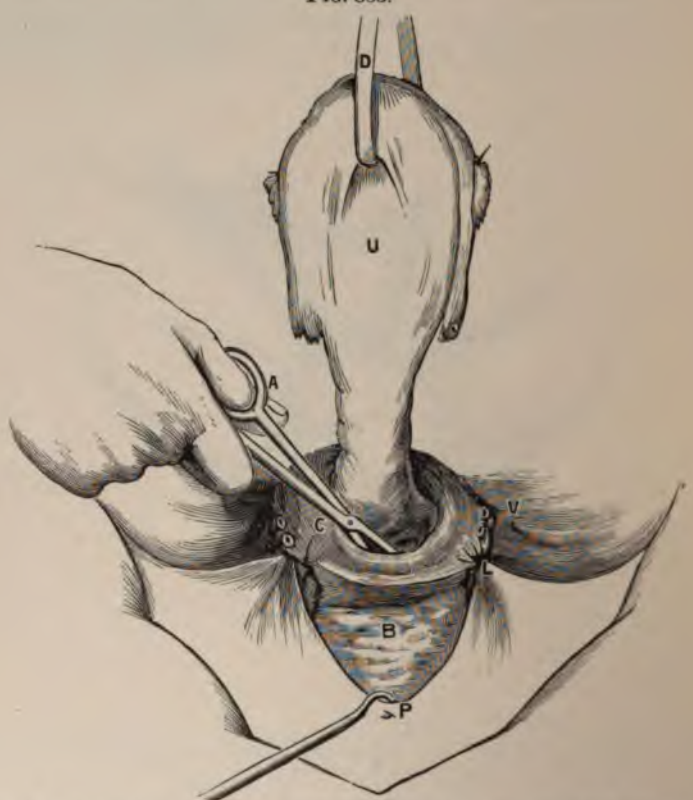


R, rectum; *C*, Douglas's cul-de-sac; *T*, utero-sacral ligaments; *L*, interlocked double ligature securing upper vaginal arteries and uterine artery (ligature holding upper vaginal arteries and utero-sacral ligament is below, and is tied behind; end left long in the cut to indicate the knot); *U*, posterior face of the uterus; *S*, scalpel enucleating the lower segment of the uterus from its external root; *V*, volsella drawing the uterus forward and downward to facilitate the operation.

A double ligature is passed from behind forward, entering close to the uterus just above the utero-sacral fold, and running beneath the uterine artery to emerge anteriorly about midway the cervix; the upper ligatures are now tied. The lower ligature, which interlocks with the upper, is now repassed below, so as to include the tissues which have been thrust aside from the front in separating the bladder: it will therefore enter close to the side of the vagina anteriorly, about opposite the external os, and will emerge posteriorly beneath the utero-sacral fold. (See Figs. 331 and 332.) When tied these two ligatures will control all the vessels of consequence, the one or two small trunks remaining bleeding but little, and being always susceptible of prompt control. The next step is the enucleation of the cervix from the vagina. The process resembles the drawing of a

cork from a bottle (see Fig. 333), the intent being to leave the outer covering of the cervix, removing the central structure. To this end we make a circular incision about the cervix at the level of the internal os, and then, while traction is made upon the uterus, we turn back as a cuff the outer coat of the cervix, including the vessels at the sides. The aim, and one easy to accomplish, is to enter the vagina at the utero-vaginal juncture, which having been done, we quickly complete the separation,

FIG. 333.



Enucleation of the lower segment of the uterus from its external coat, nearing completion: point of scissors has entered vagina, and is cutting through the cervix at above the utero-vaginal junction; *D*, volsellum; *U*, anterior face of the uterus; *A*, scissors; *V*, cut ends of uterine vessels; *L*, ligature; *B*, base of bladder turned forward; *P*, utero-vesical fold of peritoneum held forward and downward; *C*, cuff made up of lower external coat of uterus, which has been separated and turned down—to be subsequently turned down into the vagina after completion of the amputation of the uterus.

and ligate any bleeding points which may appear. We then pass four catgut sutures at the four sides of the cuff—one through the peritoneum stripped from the front of the uterus, and then through the anterior edge of the cuff; another is passed through the posterior face of the cuff, entering and emerging upon its peritoneal face. Lateral sutures are now passed through the stumps of the uterine vessels. The four are now knotted, and, passing this knot into the vagina, the cuff is inverted by downward traction (Fig. 334). Owing to the possibility of infection

of the ligatures at the side of the cervix, some operators prefer to leave them long and use them in place of the lateral catgut suture just mentioned to invert the sides of the cuff, removing them subsequently from below, as is done with similar sutures after vaginal hysterectomy: this is an entirely feasible plan, and no doubt a wise one whenever infection is

FIG. 334.

Floor of pelvis after removal of the entire uterus: *B*, bladder; *V*, opening into vagina; *R*, rectum. The cuff of tissue including the cut ends of the uterine vessels (not the ovarian), which has been turned down from the lower external surface of the uterus, has been turned down into the vagina.

probable. If drainage be needed, a strip of gauze may be passed through this opening into the vagina, which latter is then to be treated as in vaginal hysterectomy, the retention catheter and vulval dressing being then used as in the latter.

The **treatment** of the abdominal cavity is the same for all cases. It is irrigated with sterilized water or sterilized normal salt solution if it has been infected; otherwise blood-clots are removed and the abdominal incision is closed without resorting to irrigation.

Abdominal Hysterectomy (*partial—two methods*).—In this operation the early steps are practically the same as in the complete operation, the divergence taking place at the cervix. Many operators prefer to leave this structure, or at least the infravaginal portion: they therefore ligate the uterine vessels at the sides of the cervix, turn down the bladder and a cuff of tissue, as described above, until they reach a point about midway the cervix, and then amputate so as to leave a wedge-shaped depression or cavity on the face of the retained cervical portion. Some dilate and cauterize the cervical canal. All cover the face by stitching the peritoneum connected with the bladder, which was taken from the anterior surface of the uterus, to that upon the posterior face of the

stump. Other operators approximate the cut faces of the cervix, and then cover it with peritoneum, as mentioned above.

Another and a rapid way of removing the uterus after this fashion is the following (see Fig. 335): Beginning, for instance, upon the left side,

FIG. 335.

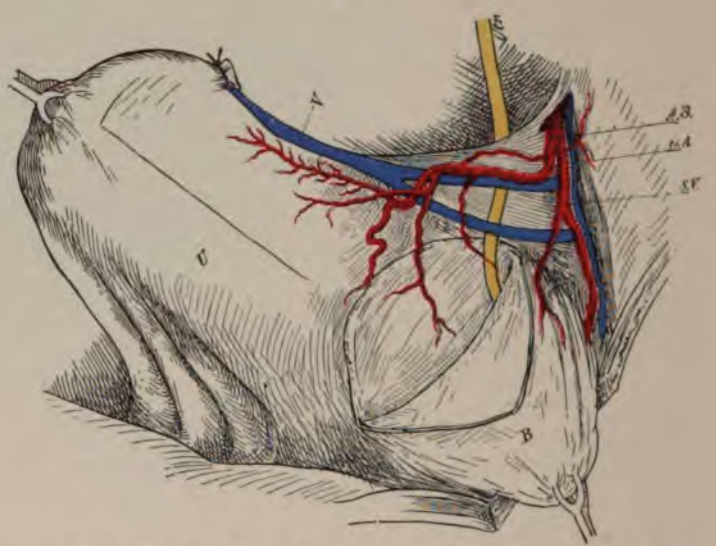
Abdominal hysterectomy—amputation at cervix. Vessels ligated from above downward on left, from below upward on right. Cervix to be retained or removed as deemed best.

ligate the ovarian vessels and round ligament *en masse*, as already described. Cut away down to the cervix, then ligate the uterine vessels, as next above described, peel off the utero-vesical fold of peritoneum, next cut through the cervix at about its middle, cutting carefully so as to arrest this incision at the opposite or right border before the vessels are reached. Now carry a ligature through the base of the right broad ligament low down, but close to the cervix, and yet above the uterine artery; then bring the ends to the left, and tie so as to include within the ligature all structures between the bottom of the cut and the region of the broad ligament: this excludes the ureter and includes the right uterine artery and important branches. Now strip the right broad ligament from the uterus to about its middle, and then tie what remains of it, together with the right ovarian vessels and round ligament, outside the ovary. The uterus and appendages upon this side are then cut away, and the cervical stump is treated as in the method of removal last mentioned. If the operator prefers to remove the entire cervix, it may be done with the cautery, as illustrated in Fig. 336, the ligatures being drawn aside to escape injury.

Abdominal Hysterectomy for Carcinoma.—In a paper upon Abdominal Hysterectomy, read before the New York Obstetrical Society, October 3, 1893, the writer in connection with the subject said: "In cancer of the uterus, especially when the vagina is involved, this suprapubic method (in the position of Trendelenburg) will prove invaluable. The sides of the uterus, the loose folds of the broad ligaments, can be searched

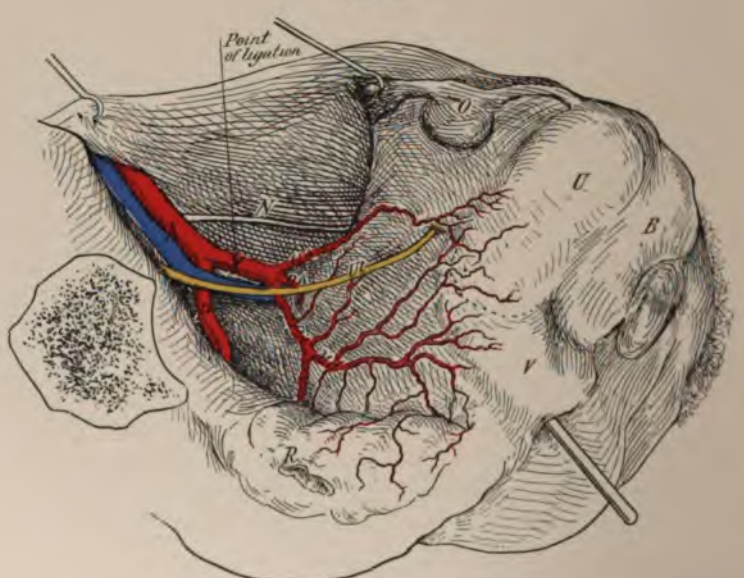
PLATE XI.

Fig. 1.



Bladder cut away from vagina to show distribution of vaginal branches of the uterus. The lower third of the ureter is separated from the vagina and drawn downwards and outwards as is required in amputation of the vagina. *B.* Bladder. *U.* Uterus. *Utr.* Ureter. *V.* Veins. *A.B.* Anterior branch of iliac. *U.A.* Uterine artery. *S.V.* Superior vesical.

Fig. 2.



Showing vaginal and uterine branches of the middle hemorrhoidal artery in the left half of the pelvis. The vagina, *V*, is separated from the rectum, *R*, as far as the perineal body and is carried forward and to the left together with the anterior face of the broad ligament, the appendages, *O*, the uterus, *U*, and the bladder, *B*. *A.* Internal iliac vessels. *P.* Posterior branch. *X.* Anterior branch. *U.A.* Uterine artery. *O.A.* Obturator artery. *P.A.* Pudic artery. *M.H.* Middle hemorrhoidal artery with rectal, vaginal, and uterine branches, the latter approaching the uterus beneath and often within the folds of the utero-sacral ligament anastomosing with branches of the uterine artery, as well as its fellow of the opposite side. This branch of the middle hemorrhoidal has been found by the writer as large as the uterine, the uterine being then proportionately reduced. *Ut.* Ureter. *N.* Obturator nerve.

for infected glands, and amputation of the vagina almost to its lower third can be easily effected."[1] This particular observation was based upon a case supposed to be malignant, but which the microscope proved to be benign. On March 20, 1894, he reported a case to the same society in which by ligation of one uterine artery outside the ureter he had secured better access to infected tissue contiguous to the uterus.[2] Subsequent experience in two cases taught him, however, that a far better command of the field of operation proposed was obtained by ligation of the anterior trunk of the internal iliac artery. This measure secured practically a bloodless field, for it controlled not only the uterine and its vaginal branches, but the vesical and their vaginal offshoots,

FIG. 336.

Enucleation of cervix, using the cautery. Gauze packed about the field to guard tissue.

together with the middle hemorrhoidal and its important branches to the posterior vaginal and cervical regions (Plate X. Fig. 2; Plate XI. Figs. 1 and 2). With this ligation he found himself free to amputate the vagina, to work in the floor of the pelvis, and, preceded by ligation of the ovarian artery and round ligament, at liberty to enucleate the uterus and excise the broad ligaments. All this could be done without the need for further ligation than pertains to one or two small points toward the rectum, and such as may result from enucleation of hypogastric glands. When to this statement we add that the time consumed was not as much as that occupied when we merely ligated the uterine artery

[1] *Transactions New York Obstetrical Society*, 1893–94, p. 27. [2] *Ibid.*, p. 315.

at its origin, the advantages of the procedure are evident. The writer has also applied this ligation to hysterectomy for fibroids and to one case complicated by pregnancy at the sixth month. Every case made a good and smooth recovery, the ample collateral circulation provided by the epigastric and obturator, the branches of the posterior trunk of the internal iliac, the superior hemorrhoidal, etc. being sufficient for all purposes. This, however, is no more than one might expect in view of the facts long known touching the results of ligation of the internal iliac itself.[1]

The writer believes that the operation has no future except in cases free from implication of the glands on the walls of the pelvis. When these, the obturator, the hypogastric, and the sacral, are involved, the superior lumbar can scarcely have escaped. All have intimate connection with the internal genitals, and when one group is infected each may fairly be viewed as diseased. If this be so, palliation is the proper course: few patients could withstand a radical operation extending to all these glands.

Having, then, an appropriate case, and assuming that the preliminary treatment has been such as to clear away all infecting matter from the uterus and vagina, we cleanse and forcibly pack the vagina full, open the abdomen freely, and place the patient in Trendelenburg's posture. Our objectives are now the vessels, the ureter, the bladder and the rectum, the uterine appendages, vagina, and, finally, the pelvic floor and walls. Ligate the ovarian vessels and round ligaments at the brim of the pelvis (Plate X. Fig. 1), draw this stump upward and outward and separate the folds of the broad ligament at the pelvic walls: drawing the posterior half of the ligament backward, we locate the internal iliac artery and follow it down to its bifurcation; isolating the anterior trunk, we ligate it just beyond this point (Plate XI. Fig. 2). It is assumed that the cornuæ of the uterus have been clamped; so, having secured the anterior trunk upon the opposite side, we are at liberty to pass on to the next objective, the ureter (Plate XI. Figs. 1 and 2). Draw the uterus forcibly upward, incise the utero-vesical fold of peritoneum, enlarge this incision laterally on both sides into the paravesical spaces as far as the pelvic wall, using the finger or director as a guide, so as to avoid injury to bladder or ureter. Now separate the bladder from the vagina until the ureters come into view, isolate them at this point, and dissect out first one and then the other as far as the pelvic brim. This is done by passing the finger or a blunt hook beneath this structure at the point of initial isolation, and, gently lifting it, we carefully separate it from its surroundings as it runs through the broad ligament. We now separate the vagina as low down as is deemed necessary, withdraw the packing, and cut the vagina off, removing it, the uterus, and appendages in one mass. If one is doubtful as to the infecting properties above the point of amputation, clamp the entire vagina with a rectangular clamp just above the point of amputation, irrigate the canal below this point afresh, and then cut through. Now clear away all suspicious tissue at the pelvic floor, examine the obturator and hypogastric glands, removing them if it be deemed best, and finally cut away the remnants

[1] The uterine and vesical arteries sometimes spring from the obturator when it is a branch of the posterior trunk. If this be so, it is easily isolated just below the anterior trunk, and can be included in the same ligature.

of the broad ligament. If the patient's condition permits, we may approximate the basic lines of this ligament to cover in the raw surfaces which will otherwise be left. We have assumed that the ureters and the bladder have escaped infection, as we infer, if the contrary condition prevails, such an extensive glandular extension exists as will render the operation useless; but should we deem it proper to attack the infections on the ureters or the bladder, this can only be done by excision. A limited infection on the bladder may present no special surgical difficulty, but it is different with the ureters. Here resection, with connection of the renal end of the ureter to the bladder by an artificial opening in the upper part of this viscus, must be made. This presupposes an infection sufficiently near the bladder to permit, after resection, the union in question. This limit is easily determined by the degree of tension upon the ureter needed to effect the junction.

The subsequent **treatment** of the case is similar to that already advocated for all cases involving vaginal drainage.

In this connection we reproduce in a foot-note a plan of operation performed by Dr. J. G. Clark, of the Johns Hopkins Hospital, and reported in the *Bulletin* of that institution, July 15, 1895.[1]

Comparing the plan adopted by the writer with that formulated by Dr. Clark, radical differences are evident. They relate chiefly to the manner of dealing with the ureters (catheterization), with the sources of blood-supply, and with the manner in which the vaginal stump is managed. Naturally, the writer is quite conscious of the great value of Dr. Clark's method, yet he prefers that which he has described in this article; but no matter which prevails, he believes that each is a movement in the right direction in the treatment of malignant disease of the uterus.

Uterine Fibroids.

Myoma is the more correct term for this disorder, but the term myofibroma or fibromyoma expresses more exactly the condition, because it is one into which both unstriped muscular tissue and fibrous tissue enter, the terms myofibroma and fibromyoma designating the condition according as muscular or fibrous tissue predominates. Fibro-cystic and fibroid polypi are derivatives of fibroids, as will be shown in a description of the changes which these tumors may undergo.

Pathology.—The origin of these tumors is not clear as yet. Some trace it to round indifferent cells, others to a hyperplasia of existing

[1] "1st. Insert bougies 'into ureters' under the local effects of cocaine, thus saving time and conserving the patient's vital powers for the operation. 2d. Make abdominal incisions of sufficient length to ensure free manual movements. 3d. Ligate upper portion of broad ligament with ovarian artery, divide vesico-uterine peritoneum around to opposite side, push bladder off, and spread layers of ligament apart, exposing uterine artery. 4th. *Dissect uterine artery out for 2½ cm. from uterus beyond its vaginal branch and tie.* 5th. Dissect ureter free in the base of the broad ligament. 6th. Ligate remainder of broad ligament close to iliac vessels, and cut it away from its pelvic attachment. 7th. Carry dissection well down below carcinomatous area, even though cervix alone seems to be involved. 8th. Proceed on the opposite side in the same manner as on the first side. 9th. Perforate vagina with sharp-pointed scissors, making strong traction on uterus with small volsellum forceps, so as to pull the vagina up and make its walls tense; then ligate in small segments (1 cm.), and cut each segment as it is tied. 10th. Insert iodoform gauze from above into raw space left by the hysterectomy; draw vesical and rectal peritoneum over this with a continuous fine silk suture. 11th. Irrigate pelvic cavity and close abdomen without drainage."

muscular fibres. We can only affirm at present that they spring from a matrix of myoblasts in the tissue of the uterine wall, and that in some cases this matrix may be in the wall of a blood-vessel which is undergoing obliteration. They are developed in the body and in the neck of the uterus, but far more commonly in the former, appearing indiscriminately at the cervix, the fundus, or upon the sides. There may be but one tumor, but more frequently we find several of varying dimensions. The effect upon the uterus is that of a stimulant to increased growth; so we find the organ enlarged as a whole, the change being equally marked in the cavity, which is increased in all directions. The endometrium is the seat of hypertrophic changes (endometritis fungosa), and, as will be explained later, may subsequently suffer atrophic changes depending upon pressure. The difference in the relative amount of fibrous and muscular tissue present in these tumors is the reason for the decided variation in their gross and microscopic appearances. Some myofibromata are so soft and vascular, and even symmetrical, that at first sight one might suppose the condition to be that of pregnancy; while, on the other hand, some fibromyomata are so hard, so anæmic and nodular, as to suggest the presence of an enchondroma. Between these extremes we find the average conditions, but this inclines rather to the fibromyoma than the myofibroma. Originally, the relative amount of the two tissues is the same for all, but with growth the tendency in most of them is to an increase of the fibrous at the expense of the muscular tissue. Myofibromas appear more as an integral part of the uterine wall, whereas the fibromyomas are seen as hard, dense tumors imbedded in the wall and separated from the surrounding tissues by a capsule of greater or less completeness. The capsule, however, is nothing more than the surrounding uterine tissue, which has been condensed by the outward pressure of the expanding tumor. In general, all these tumors are more compact and contain less fluid than the surrounding tissue, the blood-supply, as a rule, being less abundant than that found in the latter region. The neighboring vessels in the uterine wall are dilated, forming a system of sinuses not unlike those seen in the pregnant uterus. The vessels which pass from this system into the harder tumors are neither abundant nor large as a rule, so that the tumors may generally be enucleated without risk of excessive bleeding. The lack of bleeding, however, is as much, if not more, due to the subsequent contraction of the uterine tissue about the bed of the tumor as to the smallness or absence of vessels. Where this contraction fails, as it does sometimes when the amount of surrounding normal uterine tissue is limited, one may have persistent oozing or even active bleeding from this bed. In pure myomas the extent of blood-supply is more akin to that found in the uterine tissue proper, so that both on this account, as well as the deficient or absent capsules, enucleation becomes a far more difficult procedure. Sometimes these tumors are penetrated by a vascular system similar to that found in the surrounding uterine capsule: we then have wide cavernous blood-channels extending in every direction throughout the growth. On the other hand, tumors present themselves in which the lymph-spaces are widely dilated, giving us a cavernous, but less vascular structure. The first are called telangiectodes, the second myoma lymphangiectodes. Cyst-formation within fibroids (fibro-cysts) is traceable to

each of these conditions, but of the two the latter appears to be the more frequent point of departure for this form of degeneration. In spite of this abundant supply of vascular and lymphatic structure, the nerve-supply is quite deficient, nerves having been found in but few.

Naturally, the cut surface of these various forms of fibroids will differ materially: the myofibroma will present a surface closely resembling the neighboring uterine tissue; the fibromyoma a more or less white, tendon-like appearance, with a more or less clearly defined capsule; while the cavernous or cystic forms will show a cut surface chiefly made up of excavations filled with blood or serum. The dimensions attained by fibroid tumors differ according to the stage of development. Taken as whole, the entire mass rarely attains the size of the largest ovarian tumor, but in one instance it reached the enormous weight of one hundred and forty pounds. Viewed from the standpoint of location as relates to the wall of the uterus, fibroids are called interstitial or intramural when surrounded by uterine muscular tissue; when they encroach upon the cavity of the uterus, having only a covering of endometrium, they are called submucous; and when they encroach in a similar manner upon the peritoneal aspect of the uterus they are called subserous. In the process of growth any interstitial tumor may become, on the one hand, submucous, or on the other, subserous, according as it extends toward the inside or the outside of the uterus. Submucous and subserous fibroids are either sessile or pedunculated, in keeping with the degree of separation from their original bed in the wall of the uterus which they may suffer. This separation is due to the contraction of the enveloping uterine tissue, the tumor receding in the direction of least resistance, and continuing to recede so long as the contraction persists. By this means many of them finally become attached to the uterus by so thin a pedicle that they may be separated spontaneously, being thus cast out into the vagina free, or, if subserous, sink to the lower part of the peritoneal cavity. They may remain in this latter position for an indefinite period, drawing nutrition from mere contact with the serous fluids of the peritoneum. All pedunculated fibroids are liable to such accidents as torsion, leading to necrosis, which in the peritoneal cavity would mean a more or less extensive peritonitis. Apart from this accident, however, peritonitis is a frequent complication of fibroid tumors. It appears to be due in part to pressure-effects, in part to interference with local circulation and to salpingitis as a derivative of an endometritis, also a frequent complication. To a greater or less extent ascites is present with the larger tumors, but the fluid is generally a straw-colored serum, though it may be dark from extravasation of blood. As a result of the local peritonitis adhesions are common, and these, becoming freely supplied with blood-vessels, may be the source of a considerable supply of blood to the tumors as a whole. From the standpoint of the operator these adhesions are of special importance, in accordance with their extent, their density, and their vascularity. The evil influence of adhesions may be paramount before operation, however, as, for instance, when they hold the tumor down in the pelvis, and, its growth continuing under such circumstances, we have added to the pathological picture those changes due to compression of the bladder or, worse still, of the urethra,

retention of the urine being then a factor in the case; or it may be compression of the ureters with a possible hydronephrosis. The rectum is necessarily interfered with, but as great a source of discomfort as any are the pressure-effects upon the nerve-trunks within the pelvis. A pressure-effect may be present quite independently of the influence of adhesions, as witnessed with tumors which develop beneath the peritoneum, such, for instance, as those which, springing from the sides of the uterus, grow out between the folds of the broad ligament as intraligamentous tumors, reaching large dimensions, or, springing from the lower third of the uterus posteriorly, or even anteriorly, develop under the peritoneum. The posterior tumors are the most vicious in this field of action, but, fortunately, they are just the growths most readily reached by a vaginal myomectomy. Reverting to the submucous forms, we find them of interest from many points of view. The relation to the endometrium accounts for the frequent, if not constant, association of endometritis fungosa, which lesion in turn explains the hemorrhages which either as menorrhagia or metrorrhagia are more or less constant attendants upon submucous fibroids. The effects upon the endometrium likewise explain the serous leucorrhœa so prominent and persistent in some cases, and the relation of this form of growth to the uterine cavity accounts for much of the pain accompanying them. This relation is such as to produce distention of the cavity, and thereby provoke contraction, in consequence of which the pedunculation of the tumor is furthered and its expulsion from the cavity into the vagina perhaps ensured. When such tumors are attached to the fundus inversion of the uterus is a common result of this expulsion, provided pedunculation fails to occur, the broad sessile attachment being that which is favorable to the accident. The compression which the softer and more vascular forms of submucous fibroids undergo in this process of gradual expulsion results not infrequently in sloughing of the lower portions of the growth, giving us the sloughing fibroids so often mistaken for sarcoma sloughing from similar causes. A curious example of the expulsion of a submucous fibroid is that which is witnessed in what are called "intermittent polypi." The tumor becomes swollen and softened from the engorgement of menstruation, and the uterus, provoked to action, expels it into the vagina. In consequence of the depletion incident to the menstrual flow the tumor shrinks sufficiently to pass back through the cervix into the uterine cavity, where it remains until the next menstrual epoch. The influence of pregnancy upon these tumors is such as to lead to an increase of their substance so long as the pregnancy lasts, the increase being part and parcel of that common to the entire organ under such circumstances; but they are also subject to the influences of involution, so that not infrequently they disappear as this act is completed. It is fair to assume, however, that the myofibromas are more likely to undergo this favorable change than those composed wholly of pure fibrous tissue.

Degenerative Changes.—These changes appear to be more common with tumors springing from the body of the uterus. When such growths are pedunculated the blood-supply is proportionately diminished, and if they do not receive a fresh supply through adhesion, as in the case of the subserous forms, fatty degeneration and calcification are not uncom-

mon. After the menopause these alterations are more apt to occur, the normal atrophic changes of the entire genital tract conducing of necessity to this end. All tumors, no matter where placed, are then subject to this form of degeneration, the menopause marking for fibroids in general the beginning of retrogression. Interstitial extravasation of blood may occur, creating cavities, and thus leading to the formation of fibro-cyst. This condition may also spring from an œdema of the growth, large spaces resembling cysts being thus created. Cysts may also result from the obliteration of the large blood-channels in the form known as myoma-telangiectodes.

Myxomatous degeneration is another form of retrogressive change to which these tumors are liable, and from this cysts may also develop. The more common source of fibro-cystic degeneration appears to be dilatation of the lymph-spaces by accumulation of serum in the meshes of the growth and by the resorption of myxoid tissue. By the absorption of the intervening walls several such cysts may be converted into one large cavity, which by subsequent increase may attain a capacity sufficient to contain many quarts of fluid. It is well to bear in mind the possibility of sarcomatous degeneration in all cases of fibroids; for, while it is far from a common form of degeneration, yet should it develop, the rapidity of systemic infection would make prompt operative treatment urgent. Apart from the infections of a puerperal fibroid uterus, suppuration in fibroids is also an uncommon ending; but the low vitality of these structures exposes them to the extreme action of the septic pyogenic germs, so that septic infection of a fibroid puerperal uterus may be expected to cause suppuration in these masses. From what has been said concerning the amount of blood contained in some of these tumors, and from what has been also said touching the thinness of the walls of the cavernous sinuses, it is not surprising that hemorrhage into the peritoneal cavity of considerable, and even dangerous, degree has been observed. In fact, death might readily result from such an accident. Spontaneous separation of subserous fibroids has already been noted, but owing to the supply of nutriment afforded by the peritoneal fluids such growths, while suffering from degeneration, remain to vex and annoy the patient. A more favorable termination is sometimes found with submucous fibroids, for after expulsion from the uterus they may undergo spontaneous separation and be wholly expelled from the vagina, the patient being rid of that one tumor at least.

The causes of uterine fibroids are obscure, but menstrual activity exercises a powerful influence. This is the period in life in which they appear, having been observed as early as the age of ten, but the span of life from twenty-five to thirty-five is most prolific. They tend to degeneration, usually fatty and calcareous, after the menopause, but are potent to prolong the period of menstrual activity some years beyond the usual date of cessation. This is due to their influence upon the endometrium already noticed, and to a possible influence upon the function of ovulation. Race is supposed to have a bearing upon their development, because it has been maintained that the negro is especially liable to fibroid diseases in the uterus. The writer is disposed to attach more importance to sterility as a direct causative agent than any other, and abortions may also be assumed as agents of production. When the

stimulating influences of menstruation and conception reach their normal climax in completed pregnancy, the orderly changes of nutrition are provided for: when, on the contrary, these are arrested, as in abortion or in the oft-repeated return of a sterile uterus to its premenstrual condition, analogy would teach that this kind of unsatisfied growth might set up those changes in some one or more of the matrices of myoblasts which exist throughout the organ, from which there is reason to believe these tumors originate. The writer doubts the causative influence of mere inflammatory changes in the uterus or appendages, as those which are found coexistent with fibroids seem to be more a result than a cause. So far as the appendages are concerned, the writer's experience teaches him that a large number of fibroids are free from inflammatory changes in these structures. He would therefore feel that sterility and abortions were predisposing causes, but not inflammation.

The Symptoms and Signs.—The symptoms of fibroids may be grouped around the phenomena of pain, hemorrhage, hydrorrhœa, leucorrhœa, abdominal enlargement, the pressure-effects, and the effect upon the circulation and upon the general health. The discomfort suffered by these patients is not always in proportion to the size of the tumor, many small ones causing more annoyance than one reaching to the umbilicus. Inquiry as to a reason for this leads us to a consideration of the sources of the discomfort or pain within the fibroid tumors. It comes from the pressure of the growing nodules or tumors upon the parenchyma of the uterus. This is a dull or aching sensation. Pain is also due to the downward dragging of a heavy uterus upon its support. This is the chief source of backache, post-cervical and occipital pain. The pain or discomfort coming from outside pressure is first shown in the effect upon the bladder, necessitating frequent micturition, or, when the bladder is drawn upward and the urethra compressed by a tumor springing from the lower segment of the uterus, by retention of urine and distention of the bladder. Some of the discomfort of this early pressure—and, for that matter, of the late as well—is from constipation, and after a time from hemorrhoids. When from any cause the tumor remains in the pelvic excavation, these conditions are intensified, and the distress due to the pressure upon the nerve-trunks arises. From what has been said as to the accidents and complications liable to appear, it is evident that other sources of pain are salpingitis and peritonitis, or, it may be, from torsion. One of the most striking manifestations of pain is that witnessed in consequence of the attempt at expulsion of a submucous fibroid. This pain resembles that which is present in abortion, but is less active and less persistent, appearing generally with the onset of a menstruation and ceasing as the act is completed. Pain accompanies the onset of menstruation in many cases merely as the result of a stenosis of the cervical canal, retarding the escape of the blood, and every pain and discomfort that may be present in any individual case is, for self-evident reasons, accentuated just before and at the onset of a menstrual flow. It is evident, then, that pain of some sort is a constant companion of fibroid tumors, the organ or region involved and the special function attacked determining its peculiarity or character. The pressure-effects depend in a measure upon the situation of the growth: when it is fixed in the pelvis as by adhesions, for in-

stance, every organ and structure situated there suffers. Constipation and hemorrhoids, as we have seen, will appear, sciatica and crural neuralgia may develop, but the most serious effects are those produced upon the bladder and upon the ureters and kidneys. If the bladder is compressed, no real harm may arise, nothing beyond a mild cystitis; but if the outlet of the organ is compressed, then it is distended and the usual results of over-distention of the bladder may appear. Dilatation of the ureters as the result of direct compression is rare, but pyelitis as the result of the extension of inflammation from the bladder upward is sufficiently common to warrant energetic efforts to prevent so disastrous a complication. In rare cases the pressure upon one set of iliac vessels may cause œdema of the corresponding extremity, and it is conceivable that a case might present itself in which this state of affairs was present upon both sides. The enlargement of the abdomen caused by these tumors is less rapid in its development than that occasioned by pregnancy or by ovarian tumors. It depends, of course, upon the rate of growth of the tumor. This may be slow for quite a time, so that the pelvis may be easily able to hold it. Under such circumstances there may be no enlargement appreciable to the patient, but when it rises from the pelvic excavation it may be said to be self-evident: rapid growth may now appear, and in a short time great distention may be accomplished. Hemorrhage such as menorrhagia and metrorrhagia, more particularly the former, are common symptoms in this disease. These hemorrhages, however, belong to the forms in which the endometrium is implicated—the submucous and interstitial varieties. The tendency is toward a persistent increase of this flow until the menopause, which, as we have seen, is postponed much beyond the usual date. Cases in which the tumors are subserous suffer far less from this symptom than other forms; in fact, some of these may have little more than normal menstruation. On the other hand, submucous tumors are particularly prone to its development sooner or later. Profuse leucorrhœa, amounting to hydrorrhœa in some cases, is a prominent symptom. Here, again, the submucous tumors are the main sources of origin, the large sessile submucous tumors furnishing the greatest amount. It will accumulate sometimes in the uterine cavity, and, coming away in a sudden gush, suggests a discharge of urine. No patient can suffer such losses as this flow of blood and serous fluid entails without the speedy development of anæmia proportioned to the amount and persistency of the loss; and from this anæmia must spring more or less disarrangement of every function in the body. Naturally, the heart's action must first suffer, but this is more from functional weakness than interstitial disease, but the growth of large vascular tumors no doubt entails upon the heart labor which it cannot always act up to without calling into play an increase of growth analogous to that seen in pregnancy. When this is superseded by fatty degeneration, we have that form of organic heart disease which has been observed in connection with extreme cases of fibroid disease of the uterus.

The not infrequent occurrence of peritonitis as a complication of fibroids and its influence upon the tumor and its surroundings compel something more than a passing notice. It may be an acute or a subacute process. When acute it generally results from a salpingitis, and is

characterized by localized pain and tenderness, by a rapid pulse, and by some increase of temperature. After the subsidence of the acute symptoms soreness over the tumor remains for a variable length of time. When it is a subacute process there is a persistent soreness and tenderness in the affected region. In both acute and subacute forms more or less serous exudate appears in the peritoneal cavity, constituting in some cases a genuine ascites; this form of exudate is more common as a sequence of the subacute form. Permanent adhesions between the tumor and adjacent viscera are the result of the acute form, but both may furnish adhesions of equal strength and tenacity. The symptoms of torsion are very much like those of acute peritonitis, and peritonitis is always an immediate signal of the mishap; but in torsion the pain is a very sudden development, being intense at first, accompanied by some shock or perhaps vomiting, the shock being proportioned to the size of the growth involved in the torsion.

Sloughing of a fibroid is indicated by constitutional symptoms whenever there is an absorption of the necrotic fluids. They are the usual symptoms of sepsis, and are mild or virulent in accordance with the degree and rate of absorption. It is obvious that sloughing of an exposed surface, such as the face of a submucous fibroid, is far less serious than the same process in the depth of an interstitial growth. Acute and virulent sepsis would mark the latter, while the milder process would accompany the former, as a larger part of the poisonous fluids would be discharged, giving to the vaginal flow the characteristic odor of necrosed tissue. In general terms, it can finally be stated that fibroid tumors of the uterus are marked by symptoms of fulness and pressure in the pelvis, by gradual enlargement of the abdomen, by menstrual disorders, by more or less pain and tenderness in the lower abdominal and pelvic regions, and by more or less deterioration of the general health, as shown in anæmia and its results, with the addition of digestive disorders, constipation, and loss of muscular strength and nervous energy. When the menopause approaches we have a right to anticipate cessation of growth in the tumor and improvement of the patient's local and general condition.

The **diagnosis** of fibroid tumors cannot be made without a careful study of the signs of the condition accompanying them, comparing them with those pertaining to other states which resemble fibroid disease. During the initiation of the disorder, before the symmetry of the uterus is marred, signs are negative unless there be a submucous growth; then it simulates endometritis hæmorrhagica. It can be distinguished, however, by the progressive increase in the size of the uterus, by the greater amount of dull aching pain, by its more pronounced hardness, and finally by the result of digital exploration of the cavity of the uterus after a dilatation of the cervix by tents. A favorable time to explore the cavity of the uterus in these doubtful cases is during menstruation, when the cervix is apt to be soft and dilated or dilatable. A careless observer might mistake the bleeding and the expulsive pains of a pedunculated submucous fibroid for similar conditions due to an abortion, and even after making an examination might be misled by the dilated os and protruding mass; but the antecedent history of the two conditions is essentially different, and the physical characteristics of the mass pro-

truding are dissimilar: the fibroid is hard and cannot be readily torn with the finger; the decidual tissue has just the opposite characteristic, and, morever, the detached tissue will quickly show under the microscope to which condition it belongs. Finally, the decidual mass can be quickly separated and withdrawn from the uterus, while the attachment of a fibroid prevents this easy removal. Glandular polypi and the fibrous polypi which follow childbirth or abortion can be differentiated by the microscope. In all doubtful cases the uterine sound is invaluable: we learn by it the dimensions of the canal; one can also map out a growth within the cavity, and can tell the relation of the cavity to masses on the surface of the uterus or near it. In this way small subserous tumors upon the posterior or anterior surface, causing a resemblance to retro- or anteversions, can be differentiated by bimanual palpation, vaginal and rectal palpation being, together with the sound, conclusive in these cases. The masses superimposed upon the uterus by hæmatocele, pelvic peritonitis, salpingitis, hydrosalpinx, ovarian abscess, and ovarian tumors can all be differentiated by this use of the sound, conjoined with bimanual palpation. Additional light can be had from the previous history of these states. Careful inquiry upon this matter should therefore never be omitted—an inquiry, by the way, which should be made always in all cases, no matter how simple they may appear. The most difficult cases of the last-named group are those instances of salpingitis plus ovarian abscess or ovarian cyst (dermoid or even malignant sometimes), in which repeated attacks of peritonitis have united the uterus and the mass or masses into one solid, irregular tumor. The confusion is occasioned by the possibility that a fibroid uterus may have a complicating salpingitis and peritonitis, with much the same history, even to the menorrhagia. There may be about as much hardness in one growth as the other, and the state of the general health may be much the same, except in the case of malignancy. A careful examination under ether, together with aseptic aspiration of the tumor—vaginal by preference—will be the only sure resource: this will determine the diagnosis. A uterus bicornis, especially if endometritis hæmorrhagica be associated with it, has been mistaken for a fibroid uterus. We rely upon the sound, conjoined with bimanual vaginal or rectal palpation, for the differentiation. The sound will detect the double cavity in the former condition. The differentiation of a fibroid polypus from inversions of the uterus is also made by the sound, conjoined with bimanual palpation. The sound shows the shallow cavity in the inversion, and palpation by the rectum shows the cupping of the fundus of the uterus.

A more difficult problem is the differentiation of simple inversion from that due to the action of a fibroid polypus inverting the fundus: both are instances of inversion; consequently in both there will be a reduction in the depth of the cavity and a cupping or depression at the fundus, as revealed by the rectal examination. The history of the case is important, for one variety is the result of labor, while the other may occur in a woman who has never been pregnant. The crucial test is found in an incision into the covering of the protruding mass. If it be a fibroid, a capsule is found, out of which characteristic fibroid tissue can be enucleated; if it be the fundus of the uterus, no such capsular formation is present; the covering structure is intimately united over

the whole surface with the underlying tissue. If it be of urgent importance to solve the problem, the above methods failing, then an exploratory vaginal incision, made after the most careful cleansing of the vagina and uterine cavity, will determine it.

The differentiation of fibroids from ovarian tumors is not always an easy matter. The difficulty arises in conjunction with large pedunculated subserous fibroids and with fibro-cysts. It should be remembered that fibro-cysts are rare developments compared with ovarian; that they are far less common below the age of thirty-five than the ovarian; that the general health suffers more quickly in ovarian tumors; and, finally, that the condition and relation of the uterus differ in the two states. As a rule, the uterine cavity is decidedly enlarged in fibro-cysts and the organ is drawn upward, whereas in ovarian tumors the dimensions of the uterine cavity, while increased in length, are so but moderately; then, too, this organ is driven downward, as a rule, by ovarian tumors. Conducting the examination under ether, it is possible by means of a rectal examination to map out the relation of the tumor to the uterus; in this manner we can often tell to which class the growth belongs. It may be added that fibroids and fibro-cysts develop more slowly than ovarian tumors, but, after all, as both conditions call equally for removal by operation, an absolute diagnosis beforehand is not essential in every case.

Malignant disease of the cervix of the uterus can never be confounded with fibroid disease unless it be in those rare instances of cervical tumor which simulate sarcoma: the exposed position of the growth, however, renders it an easy matter to secure enough tissue for microscopical examination; and this test will quickly determine the question. Malignant disease of the body of the uterus will more easily deceive one. In one class of cases the resemblance depends upon the menorrhagia or metrorrhagia which may be present: the curette is a valuable aid in all these cases, for by removing with it enough tissue from the cavity we can bring the microscope into play, and thus quickly settle the diagnosis.

Sloughing fibroids can be differentiated in the same manner from intra-uterine sarcomatous growths, the similarity of symptoms and gross conditions making it, in fact, sometimes difficult to determine this question in any other way.

Pregnancy is a condition which should be ever in the mind in facing the problem presented by fibroids.

It is easier to determine as between fibroids on the one hand and pregnancy on the other than between fibroids alone and fibroids complicated by pregnancy. As between fibroids and pregnancy, we are guided by the following considerations: Pregnancy furnishes the general as well as the local symptoms and signs of that condition; fibroids do not, except in a limited degree. Fibroids cause little or no change in the breasts, menstruation is uninterrupted or profuse, the uterine tumor lacks the softness and symmetry of a pregnant uterus, and if it be large enough to resemble late pregnancy we fail to get the fœtal heart-sounds, the movements, and the ballottement. The softening of the cervix or blueness of the lower genital tract is not comparable under any circumstances with that invariably present in pregnancy. Reverting to

auscultatory signs, it is well to recall the fact that large fibroids sometimes furnish a bruit like that produced by the vessels of the pregnant uterus, but there is nothing presented in any manner like the fœtal heart-sounds. When fibroids are complicated by pregnancy our diagnosis rests upon the following conditions: Pregnancy is indicated by the presence of the general symptoms and signs of that condition, in conjunction with a uterus which is lacking in symmetry, whose outlines present protuberances or extended elevations above the natural contour-line of a normal pregnant uterus. Recognition of this lack of symmetry is comparatively easy, especially if anæsthesia is called to our aid: one's attention, therefore, should be applied particularly to the recognition of the presence or absence of the signs and symptoms of pregnancy, resting satisfied only with the negative as well as the positive assurances. Unfortunately, the sound cannot be brought to our aid; if it were proper to use it, valuable additional information could be obtained.

The **physical signs** distinctive of a fibroid tumor differ materially according to the size of the growth. When the uterus as a whole is small and symmetrical, as in certain instances of submucous tumor, the organ is enlarged, hard, and globular. If there be interstitial, or more especially subserous, growths, these are shown by the irregular or nodular outlines of the mass. Pedunculated subserous tumors can be isolated and moved about freely. Myomas and cystic growths are softer than pure fibroids. The sound, conjoined with bimanual vaginal or rectal palpation, conducted under anæsthesia if necessary, will show that the body of the uterus has an intimate relation to all these growths, even to the pedunculated variety, if we can reach the pedicle. The abdomen enlarges in keeping with the growth of the tumor, but does not, as a rule, present the symmetrical outline characteristic of pregnancy or even ovarian tumors. In the absence of adhesions these tumors are quite movable, but they may be absolutely fixed—as in the pelvis, for instance—by these adventitious developments.

When ascites is present it causes symmetrical abdominal enlargement. We then get greater pouting of the umbilicus, fluctuation, and a change in the dulness of the flanks by altering the position of the patient; palpation will reveal a mass separated from the abdominal wall by an elastic cushion, as it were, this sensation being imparted to the examining fingers by the interposed fluid. As a rule, this fluid has a deep straw color, but in case of hemorrhage it may be dark, but not persistently dark and bloody, as is the ascitic fluid of malignant disease.

Prognosis.—From the standpoint of life the prognosis in this disease may be considered not unfavorable. The nearer the development is to the menopause, the stronger may be our assurance upon this point, because the natural tendency to disappearance after that period may be relied upon in the large majority of cases. A rapid growth, excessive hemorrhage, and hydrorrhœa are unfavorable indications, and, still more, sloughing, suppuration, or malignant degeneration; complications dependent upon pressure are unfavorable, and this is particularly true of those interfering with the ureters, with the circulation, and with respiration. Pregnancy is an unfavorable complication, except with the smaller tumors and those well removed from the lower segment of the uterus.

Abortion is apt to result, and, if the case goes to term, inertia of the uterus may appear, and not infrequently post-partum hemorrhage. It is evident that any growth so placed as to obstruct the birth of the child will call for operative interference, and this may be so serious as to cost the child its life or else involve Cæsarean section. Enucleation through the vagina of an obstructing tumor, with subsequent delivery of the child through this passage, has been accomplished, but the amount of hemorrhage attending this procedure is apt to mar the result. While it is true that pregnancy adds materially to the growth of these tumors, it also tends now and then to their disappearance through the process of involution; but in the event of septic infection subsequent to abortion or labor, more particularly to abortion, the prognosis is relatively graver than with a similar complication in a normal uterus.

The relatively low vitality of fibroid tumors makes them an easy prey to pyogenic germs, and the irregularities of the uterine cavity, especially with early abortion, render proper cleansing of that cavity difficult: puerperal sepsis in such cases is therefore doubly dangerous, and justifies more than any other condition prompt extirpation of the entire mass, uterus and all. The softness of such tumors and the relaxed and dilatable state of the genital passages render removal by vaginal morcellation comparatively simple and safe.

The Treatment of Fibroids.—In dealing with the treatment of other diseased states of the uterus we have confined ourselves to purely surgical procedures, because some of them, like carcinoma and tuberculosis, depend wholly upon surgery for any arrest in keeping with the preservation of the patient's life, or, like metritis, are forced toward some form of surgery if health even is to be maintained. This latter statement applies no doubt to fibroid disease in many of its phases, but there are cases in which treatment wholly medical may be all that is required. This makes it necessary to dwell upon both kinds of treatment in this affection.

It is perhaps needless to urge that the general health of every patient, no matter what the ailment, should be cared for: this includes the correction of digestive disorders and the regulation of the action of the bowels, the kidneys, and the skin. An abundant but simple diet should be prescribed; clothing appropriate to the season must be worn; moderate exercise must be encouraged; warm baths are beneficial as promoters of the action of the skin; and if the kidneys are inactive or there be an undue proportion of the urates, free drinking of one of the lighter table waters is advantageous. Vegetable cathartics of the milder type are to be preferred, and as a rule salines are to be avoided, particularly if the case be one given to excessive loss of blood or hydrorrhœa, for serous evacuations are a detriment to all such patients.

The mere presence of a fibroid tumor of the smaller forms does not forbid even prolonged exercise, for many of them are so placed that they interfere little if any with the patient's health or comfort. One may therefore be guided in such cases by the results of the exercise, forbidding it only when it is evidently harmful. Some such patients even ride a bicycle without harm to the local ailment and with benefit to the general health.

The prominent symptoms which call for special care are hemorrhage,

hydrorrhœa, anæmia, and pain. Pain may be relieved by hot vaginal douches and by anodynes, and if it be due to the downward pressure of a tumor which is not adherent, a pessary, aided by an abdominal support, may be of service. If anodynes are used, the opiates should be avoided in favor of other anodynes of a milder character, for one should be ever alive to the possibility of the opium habit in all cases having continuous pain.

Hydrorrhœa and hemorrhage call for much the same kind of treatment. Hot douches are generally efficacious in controlling both, though the bleeding is sometimes aggravated by this remedy. Both are more or less amenable to full doses of ergot, but if these fail curettage or some one of the more serious surgical procedures must be resorted to. Ergot not only serves to mitigate, and perhaps control, hemorrhage, but it has a decidedly beneficent influence upon the soft myomas, and sometimes even upon the harder or more purely fibrous growths, causing, especially in the former, an arrest of growth and even some diminution. Neither appears to be permanent, however, renewed growth returning upon the cessation of the remedy. To be of service ergot must always be given so as to produce its physiological effect upon the patient, and, combined with digitalis, it acts especially well in controlling hemorrhage, but when given for its effect upon the tumor as a whole it may be given alone. The writer has found that when administered by the mouth its effects are as good as when used subcutaneously, and it is borne much better by the patient. He has never injected it directly into the substance of the growth, as has been advised by some, and doubts the wisdom of the procedure, especially as the results reported appear to be no better than those obtained by the prolonged use of the remedy by mouth. Of course the possibility of ergotism must be remembered, but careful use will obviate this risk. The fluid extract or the solid aqueous extract is the proper form for administration. The remedy may be continued for weeks, or even months, at a time, with intermission of a week or ten days every four or six weeks as conditions indicate.

Anæmia will sooner or later appear when hemorrhage or hydrorrhœa prevails, and this state adds, of course, to every one of the derangements of the general system. It should therefore be combated in every possible manner. The preparations of iron stand first as systematic remedies, but iron alone frequently fails to give an adequate result: it should then be accompanied by inhalations of oxygen gas, the inhalations being taken soon after the administration of each dose of iron. Of late beef-marrow has been used as a remedy for this defect: it can be given as an emulsion, and if taken in some vehicle, such as beef-tea or bouillon, appears to be tolerated and exerts a good influence. The waters of Schwalbach and Kreutznach in Germany and the iron waters of Saratoga are said by some to be beneficial: these, aided by the dietary, the change of scene and climate, no doubt tend to improvement and can be prescribed in suitable cases. Strong galvanic currents enjoyed until recently some reputation in this ailment, but the improvement in operative measures has now placed this treatment at a disadvantage. The current appears to aid in the relief of pain, but beyond this the writer has found that other remedies, such as ergot and the curette, which can be employed with as little risk and with less expenditure of time, will

give quite as good results, and are in the main more acceptable to the patient. There are cases of impaction of these tumors in the pelvis in which, in the absence of adhesions, the tumor may be pushed out of the pelvis, to the great relief of the patient. A pessary under such circumstances would be useful in preventing subsequent prolapse of the mass.

Surgical Treatment.—The operations which may become necessary in this disease can be best described by dividing them into two groups in accordance with the line of approach which may be demanded or which the operator may elect to follow. One is by way of the vagina, the other is that through the abdominal wall, and they may be summarized as follows: For the vaginal route they are curettement; ablation of pedunculated intra-uterine fibroids; removal of sessile submucous and certain interstitial tumors; removal of certain subserous tumors; ligation of the uterine arteries; removal of the entire mass (uterus and tumors). For the abdominal route the procedures are—removal of the ovaries with or without ligation of the ovarian arteries; removal of subserous and certain interstitial tumors; removal of the entire mass (uterus and tumors), leaving more or less of the cervix; removal of the entire mass (uterus and tumors).

Operations by the Vaginal Route.

Turning attention first to the vaginal operations—for all of which, by the way, anæsthesia and scrupulous cleansing are a necessity—we consider *curettement*. In any case presenting hemorrhage or hydrorrhœa, and in which the more radical operations are contraindicated, the sharp curette should be freely used. The writer invariably follows curettement in these patients with the gauze packing, because he believes it gives a better and more continuous result. Many of these cases have a long, narrow cervical canal with hard and rigid walls, rendering it difficult to maintain the dilatation with sufficient permanency to permit the free escape of such discharges as must result from the traumatism. The gauze packing remedies this, because it not only can remain in place forty-eight hours, but can be readily renewed as often as the operator deems proper: time is thus afforded for a proper repair of the traumatism, and the chances of salpingitis are diminished accordingly. The details of this procedure belong to that part of this work treating of the diseases of the endometrium. Patients should be made to understand that curettement is never a curative remedy for the hemorrhages of these tumors, because as long as the disease remains and the process of menstruation is active the conditions causing the bleedings will recur.

Pedunculated submucous tumors of moderate size which have passed into the vagina are removed as follows: Seized with a volsellum, they are drawn forcibly downward until the pedicle is reached; this is then transfixed and tied at its narrowest portion, after which it is cut away. If too large to permit ready access to the pedicle, it should be reduced by morcellation, after which its remnant should be drawn downward and the pedicle treated as above. Should it protrude at the external os and be too large to allow the operator to draw it into the vagina, the cervix should be incised, after which traction should be made, and, if be still held back, then it should be reduced by morcellation, after which the

pedicle may be brought into reach and treated as already stated. Sometimes there is but little dilatation of any part of the cervical canal, the entire tumor being within the cavity of the uterus. We should select the time of menstruation, and attempt at that period rapid dilatation, employing incision as an aid, and, having brought down the growth sufficiently, proceed to remove it by morcellation, ligating the pedicle as above. If, in spite of the softening influence of menstruation, the rigidity be still such as to forbid rapid dilatation, the slower method by tents is open to us; but the writer prefers to gain access by deep incision of the anterior cervical region, as will be described in connection with the removal of sessile and interstitial tumors. If there be difficulty in reaching the pedicle, one may enucleate the tumor, or at least that portion next the pedicle, and then, if there be bleeding, apply a clamp, which can be left in place twenty-four or thirty-six hours. One is tempted to cut off the smaller tumors without previous ligation, and with the larger ones to rest content with enucleation. If prompt uterine contraction can be secured, it is perfectly safe to do either, but should it not be—and sometimes it fails us—troublesome bleeding may arise. Ligatures should be left long enough to reach into the vagina, so that should they fail to come away spontaneously they may be detached later by traction. Sessile submucous, and even the interstitial, tumors which project sufficiently into the uterine cavity can also be removed, provided we can gain access to them. This depends upon the state of the cervix and the relation of the tumors to the cervix. If this is open or if it can be opened, and if the growths are low down in the uterine cavity or can be drawn down, the procedure is as follows: The capsule is opened at the most dependent part of the growth: it is then turned back, so as to permit the volsellum to grasp the uncovered tumor; this is then pulled down, while, with the finger or some such enucleating instrument as the spoon-saw, the tumor is separated by traction alone or combined with a twisting motion; the tumor can thus be freed and drawn from its bed. In the process of enucleation care must be taken to hug the growth carefully, so as to avoid, especially in the case of interstitial formation, penetration of the uterine walls. Some morcellation may be needed, but this can be done without fear so long as the capsule is respected. As soon as the growth is removed the chances are in favor of enough uterine contraction to control bleeding, but, should any continue, clamps may be left upon such points. In this way one or more growths may be successfully removed. A serious difficulty is present, however, whenever the cervix is closed, is long, and is rigid, for then dilatation, even at the menstrual period, and even aided by the usual incisions, may be practically impossible. The choice then lies between removal of the uterus as a whole and an incision throughout the entire cervix into the uterine cavity. Assuming that relief in one way or the other is imperative, the question turns upon the state of the patient: if it be poor, owing to the greater liability to sepsis from such an enucleation, in such a patient the writer would prefer total removal, but if the conditions be good, enucleation may be carried out. It is conducted as follows: Separate the entire anterior vaginal attachment from the uterus with the thermocautery; peel back the bladder so as to push up the attachment of the peritoneum to the anterior face of the uterus; conduct this carefully, so

as to avoid entering the cavity of the peritoneum. Holding the cervix well down, cut it open throughout its extent, and carry the incision into the lower segment of the body below the reflection of the peritoneum. Seize the tumor, incise the capsule, and deliver by twisting and morcellation, rather than by direct traction. Let an assistant press the mass from above so as to hold it well down in the pelvis. By doing all that is possible to lessen the need for traction upon the intra-uterine tumor we diminish the chances of converting our incision into the body of the uterus into a tear which may extend into the peritoneal cavity. In all of these cases it is wise after enucleation and removal to cut away the redundant portions of the capsule. Clamps may be left in place to control bleeding. The incision should be carefully inspected to see if the peritoneal cavity has been entered, for if it has been the opening should be closed. It is also essential that the bed from which the tumor has been removed, as well as the cavity of the uterus, should be packed with sterilized gauze, and that the subsequent care of the case should be similar to that required in vaginal hysterectomy. This includes, of course, the use of the self-retaining catheter. Some operators remove the cervix entire in this latter class of cases, but the writer has not found this necessary. The writer has omitted mention of the removal of pedunculated fibroids with the galvano-cautery wire or the écraseur, because he considers the methods described both safer and more efficient. Whenever the uterus is inverted, either prior to the operation or while it is being executed, it should be returned to its proper form after the operation is completed. The packing which one leaves in the uterus in these cases can be left in place, as a rule, forty-eight hours, but should temperature rise sooner, it should be promptly removed, and the cavity should be washed and re-dressed. This should thereafter be done daily until proper convalescence has been established. It is needless to urge that if the case be a sloughing fibroid the greatest possible care in all the details of antisepsis, both during and after the operation, is essential: the surgeon, too, should be in this case on his guard against the self-inflicted wounds he is so apt to sustain in difficult vaginal operations.

Turning next to *subserous tumors*, we find that those located low down on the uterus upon its posterier or anterior face can be removed through the vagina, provided their entire bed can be commanded. If they are too large to permit this, the operation should not be made that way. This implies that only smaller fibroids should be so treated. The danger of hemorrhage is the chief cause of the limitation, but an additional cause is the difficulty experienced in properly covering over the bed of the growth with the peritoneal capsule, from which most of them may have to be enucleated. A roomy vagina, a broad and shallow pelvis, while not absolutely essential in each case, are necessary in some and helpful in all, as the reader can readily understand. The same proviso, by the way, holds good with pretty much every vaginal operation, as we shall state more pointedly later. Having located such a tumor upon either the anterior or posterior face of the uterus, the operation is carried out on the following lines: When upon the anterior face we cut through the anterior utero-vaginal junction with the thermo-cautery, as in anterior colpotomy. We then push off the bladder from the uterus, as in vaginal hysterectomy, reaching in this

way the lowest margin of the tumor. If this can be reached without entering the peritoneal cavity, so much the better, for we may then succeed in enucleating the growth subperitoneally. The capsule is incised, and the tumor is extracted from its bed by traction and torsion, as with submucous growths. If, on the contrary, the peritoneum cannot be sufficiently displaced to permit this extraperitoneal procedure, we then tear through that membrane, seize the tumor at its most prominent point, incise its capsule, and enucleate as before. Completing this, the edges of the capsule, when possible, are brought together with fine catgut, and, if the cavity of the uterus has not been opened in the enucleation, the incision through the peritoneum is closed, the vaginal wall being left to close by granulation. If the uterine cavity has been opened, then make no attempt to close up the capsule, but stuff gauze into the bed and bring it out into the vagina. If the enucleation has been made subperitoneally, closure of the capsule can be ignored and the vaginal wound is treated as above. It is hardly necessary to remind the reader here that curettage and cleansing of the uterine cavity are an essential part of these operations.

When the tumor is situated posteriorly, we open with the cautery, as in posterior colpotomy. Owing to the greater frequency of adhesions about these posterior tumors, special care must be directed to the protection of the rectum: this can be secured as in vaginal hysterectomy or total morcellation. These adhesions are advantageous, in that they permit enucleation without entrance to the peritoneal cavity, thus furthering upon the posterior face the purpose the loose attachment of the peritoneum in front permits. Extraperitoneal tumors are even more favorable for this operation, but more than the usual care must be bestowed upon the rectum, because of the closer relation of such tumors to that organ. We may ignore suturing the capsule in both of these classes of cases. If the tumor be free of adhesions and in no sense extraperitoneal, enucleation must be carried on as with similar tumors anteriorly, closing the capsule or not in accordance with the rule laid down for the anterior tumors, the rules for drainage being the same. Pedunculated tumors, whether anterior or posterior, can be treated by ligation alone.

Ligation of the uterine arteries is offered by some as a remedy for fibroids, the object being much the same as in ligation of the ovarian vessels—an arrest of growth. Reports as to ultimate results are too few to warrant an opinion for or against the procedure, but there appears to be abundant reason to believe that it is possessed of the advantages and disadvantages of ligation of the ovarian vessels; which are in the main arrest of growth, with a tendency to subsequent shrinkage, and a fair chance for necrosis of certain parts of the growth in some cases. The procedure is advised in smaller tumors, and is executed in the following manner: The anterior vaginal wall is separated from the uterus by preference with the cautery: a vertical opening is then made with the cautery or scissors into the cul-de-sac of Douglas; drawing down the uterus forcibly, the uterine artery is palpated between the index finger, which is passed into the cul-de-sac, and the thumb, which is passed through the opening in the anterior vagina. A ligature is now passed from before backward above the artery, and, after encircling it poste-

riorly, is brought forward beneath the vessel and out at the anterior opening, whence it is passed backward; it is then tied and cut short. The same procedure is next executed upon the opposite side; then the opening into the cul-de-sac is closed, the vagina is packed with gauze, and the operation is complete.

Removal of the entire mass (uterus and tumors) through the vagina is an operation of recent date, but it is little more than an extension of the principle of morcellation heretofore applied to the larger submucous fibroids. Some operators restrict it to masses not larger than a pregnant uterus of four months. Others, on the contrary, advocate it for such as are fully equal to a uterus pregnant six months. The smaller the growth the easier the operation. Soft tumors are likewise better fitted for the operation; therefore, myomas and the infected puerperal uterus are specially amenable to it. The condition of the bony pelvis and of the soft parts must also be considered, for a narrow virgin vagina affords less room than that of a multipara, and a wide shallow pelvis is far more favorable than a deep and narrow one; so that while it is possible to remove a fibroid the size of a pregnant uterus of four or six months the conditions enumerated as favorable must all be present. The operation is more direct, and therefore easier, when the cervix can be at once brought well down into the vagina, because we can then gain early access to the uterine arteries. When it is displaced and almost pinned against the symphysis or sacral promontory, as it may be by large subserous tumors springing from the lower segment of the uterus, reduction by direct morcellation of such tumors may be needed before the vessel can be secured. Turning now to the operation, we find that the technique differs according to the preference of individual operators, some relying wholly upon clamps, some upon ligatures, and others, again, employing one or the other as conditions favor. The writer, however, will describe the operation as he has been in the habit of performing it. It is a vaginal hysterectomy upon an extended scale, requiring, therefore, every detail of preparation, both general and local, heretofore mentioned as essential in that operation. We may incise the vaginal outlet if space is needed here: the cervix is then seized with a blunt volsellum, drawn forcibly down, and the vagina is separated from the uterus with the thermo-cautery. The bladder is pushed back, the cul-de-sac is opened, the tissues at the side of the cervix, including the utero-sacral ligament, are ligated and cut away; the next ligature can usually be made to encircle the uterine artery. When ligated, we cut away the lateral attachments of the cervix and lower segments of the uterus. This procedure is now repeated upon the opposite side. If ligatures cannot be applied, then we use clamps, one large one on each side being sufficient. If the cervix be in the way, it may be cut off prior to the ligation or clamping of the uterine artery, bleeding from it being controlled meanwhile by traction; assuming, however, that it is not, we leave it as a point for traction until the above ligation is completed; then we cut it away. Seizing the stump, we drag it down, and, completing the separation of the bladder, which, in some cases, may have been drawn upward upon the anterior face of the tumor, we sever the utero-vesical fold of peritoneum. The lower segment of the uterus is now so well cleared of its attachments that morcellation may be commenced (Fig. 337).

We have assumed, so far, that lateral and posterior vaginal retractors, as in vaginal hysterectomy, have been used. We now take the broad, long-beaked posterior retractor and carry it as deeply into the sacral curve as we can get it. The lateral retractors are likewise carried as far into the pelvis as they can be placed, and one for the anterior wall is placed between the bladder and the uterus. By these retractors we not only hold open the vagina, but shield the walls and viscera from harm during morcellation. The operation is now continued as follows: Keeping up traction upon the stump, we cut out a core from the centre of the tumor aided by the volsellum; we next cut away the sides, guarding exposed points, when necessary, by the fingers of the disengaged hand, an assistant then holding the volsellum. Returning to the centre of the

FIG. 337.

Removal of the entire uterus by morcellation in fibroid disease, shown in section: *A*, knife; *B*, volsellum; *C*, perineal retractor.

mass, we again cut out its interior; then treat the sides as before. Working in this manner, the ovarian vessels are reached; these are ligated or clamped as one prefers. Such bleeding points as may appear from the severed ends of the broad ligament between the uterine and ovarian arteries are ligated or clamped as seems best; the bleeding from the tumor is held in check by the application of steady traction, for it is useless to waste time in clamping or ligating there. The sides of the uterus are the points to aim for in this endeavor, because from thence comes the blood-supply. By these methods, using knife or scissors as seems appropriate, we finally reduce and deliver the mass. A sharp lookout must be kept for the intestines and omentum, which, if adhe-

rent, can be readily separated from the tumor. If injured, the intestines should be repaired at once. As to the tubes and ovaries, they are not disturbed unless diseased. If diseased, they are tied or clamped and removed. As soon as the tumor is removed the ligature or the clamps should be carefully examined to see if they are secure. Such bleeding points as now appear should be tied or clamped. The peritoneum, anteriorly and posteriorly, should next be drawn down and attached by two or three sutures to the cut edge of the vagina; the field is now irrigated with sterilized water; a gauze drain is passed into the peritoneal cavity, its inner end resting in the sacral curve; the vagina is packed loosely or tightly with gauze according as the opening into the cavity is small or large; and the end is brought out at the vulva, so as to be in contact with the outer dressing. Some use for the drain and vaginal packing gauze sterilized by boiling in glycerin; others rely merely upon gauze sterilized in the usual manner. The subsequent dressing, including the use of the retention catheter, is the same as already described for vaginal hysterectomy. It sometimes happens that the intestines will drop into the vaginal opening in such manner as to embarrass one in placing the gauze drain and packing in position; when such is the case it can be obviated by raising the hips somewhat while placing them. The packing should be removed on the second day, the drain on the fourth, care being taken not to use violence, for one might draw down an intestine or the omentum. If it clings, it is best to dislodge it by twisting, but a day or two more may be granted if it be at all difficult of removal. As soon as the packing and drain are withdrawn, vaginal douching with a solution of boracic acid or permanganate of potash should be instituted, the douching to be twice daily or oftener if there be appreciable odor. Morphine may be given these patients without fear of the troublesome consequences witnessed after laparotomy, and where clamps are used it is almost a necessity with many patients. The bowels are not moved until the third day, unless temperature or late vomiting occur; when either of these appears they are promptly moved. An abdominal pad and binder are always a comfort to these cases, especially if the tumor removed is a large one. As a rule, the patients are able to sit up at the end of ten days or two weeks, and have a convalescence better than that observed after laparotomy: they can return more quickly to their usual diet, and consequently regain strength more rapidly. All operators agree as to the difficulty in removal by laparotomy of tumors of size springing from the lower segments of the uterus: such tumors also make it the harder to perform either complete or incomplete hysterectomy, seeing that they obscure the pedicle of the growth. They do not offer any special difficulty to vaginal morcellation, however, unless, as already stated, they fix the cervix eccentrically against the symphysis, for instance—or unless, as with some tumors which grow laterally between the folds of the broad ligament, they envelop and obscure the uterine artery. This last condition demands patience and care in locating the vessel, else we will fill up the vagina with clamps at the outset—something to be avoided in every case. Anterior and posterior tumors which prevent access to the cervix are first removed, following out the plan of operation already described as appropriate to such subserous bodies. If during their removal there be inordinate bleeding, clamps may be freely

used, because as soon as the way to the cervix is cleared we can secure the uterine vessel and be thus rid of the clamps.

Finally, let us say that, although the operator may elect to operate through the vagina in a given case, this in no manner binds him to that route alone. If conditions are met with or arise which cannot be properly dealt with from below, we must not hesitate to enter from above.

The extensive adhesions which sometimes accompany these tumors have been regarded by some operators as so surely necessitating an ultimate laparotomy that they have been disposed to consider them as positive indications against the vaginal operation; but this is not, in reality, the case. In tumors of appropriate size such adhesions are nearly always confined to the omentum, the sigmoid, the cæcum, the appendix, or a coil of small intestines: all of these can bear sufficient downward traction to bring them into reach, so that they can be separated with comparative facility; but if this cannot be done, so as to leave a satisfactory condition behind, laparotomy should be done.

Operations by the Abdominal Route.

Removal of the ovaries, with or without ligation of the ovarian vessels, is a procedure which may be resorted to when a radical operation is contraindicated. Its purpose is the induction of a premature menopause, so as to induce atrophy of the tumor. It is specially applicable to medium-sized or small tumors—myomas by preference, particularly to those which bleed inordinately—and not infrequently an excellent result is obtained. The operation is not always an easy one, however, because the ovaries may be imbedded in adhesions, and the adherent tissue of the tumor or broad ligaments may be so vascular as to forbid its attempt: we can leave them in place and ligate the ovarian vessels at the border of the pelvis instead. If they can be removed, this should be done much after the manner employed in simple oöphorectomy, extra care being taken not to perforate neighboring vascular areas. One should not forget, in contemplating ligation of the ovarian vessels, that cases have been reported in which subsequent necrosis of the tumor has taken place. The combination of oöphorectomy with ligation of the vessels is open also to the same suggestion.

Removal of subserous and certain interstitial tumors is the operation known as myomectomy. It differs in subserous tumors according as the growth is pedunculated or sessile. If pedunculated, the operation is quite simple, being no more difficult than the removal of a pedunculated ovarian tumor. The pedicle is transfixed and tied as in ovariotomy. Should the tissues be soft, the ligature may cut through before it can be drawn sufficiently tight: in that event the stump must be treated by deep coaptation sutures, so as to compress the open vessels. In severing the tumor encroach rather upon it than the uterine wall, so that abundant tissue may be left at the stump for such measures of hæmostasis as may be needed. If the tumor be sessile, we incise the capsule and enucleate it from its bed; we then close the wound much after the manner employed in Cæsarean section: first, a row of deep sutures, then a layer of superficial, so as not only to approximate the walls of the bed of the growth, but bring together and turn in the edges of its capsule. Interstitial tumors

may also be removed by a like process of enucleation, but here there is danger of opening into the uterine cavity—an occurrence which is very liable to occasion infection of the exposed uterine tissue, and which we know to be fraught with the dangers of sepsis. If this cavity can be cut off by suturing the mucous membrane, this danger may be obviated; but one should not feel too sure upon this point, for, in spite of the prior cleansing of the uterine cavity, the danger of infection is present. Such cavities can rarely be rendered aseptic; so, upon the whole, we would prefer to remove the uterus in such a case. If we have avoided the uterine cavity in the enucleation, we then treat the bed of the tumor in the manner suggested for sessile subserous growths. The tumors best suited to this operation are those situated high up on the uterus and upon the anterior or posterior face. Tumors at the sides, while they have been removed in this way, are liable to have vascular connections of such magnitude as to endanger the result. We will allude to this again.

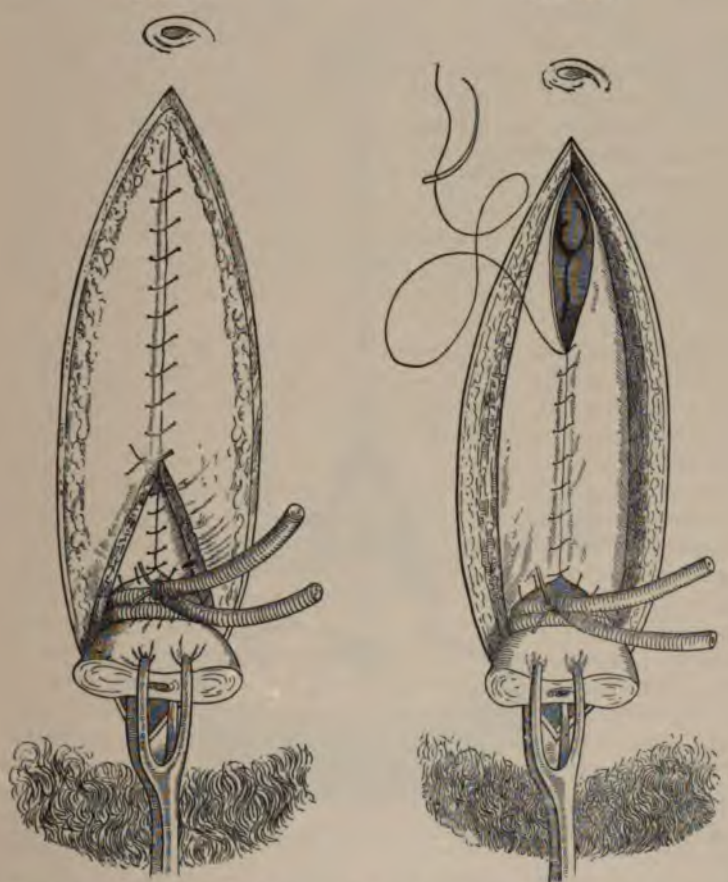
We now come to the more important abdominal operations, seeing that they involve the removal of the entire fibroid mass, including the uterus, or at least all of it except a greater or less portion of the cervix. The writer will treat of them as *partial and complete hysterectomy*. In partial hysterectomy some part of the cervix is suffered to remain, and for this purpose two types of operation are in vogue. In one the stump is treated extraperitoneally, by which term it is designated; in the other it is dropped into the peritoneal cavity, and is called the intraperitoneal method. It seems probable that in time both will be abandoned in favor of the complete operation, but a sufficient number of operators still employ them to make it necessary, if for no other reason, to describe them. In addition, there may be cases in which, owing to the state of the patient or the difficulty which some operators may experience in doing the complete operation, the partial operation may be indicated.

In all abdominal operations large tumors necessitate large openings in the abdominal wall, because their solidity forbids such reduction in size prior to removal as can be had in fluid tumors. It may be necessary, therefore, to make fully as large an incision as has been described in connection with the Porro modification of the Cæsarean section. In other words, it must be large enough to permit ready delivery of the mass.

The Extraperitoneal Method.—Having made the incision, care being taken to avoid the bladder, which may be spread out upon a good part of the anterior surface of the tumor, the hand is passed in and the surface of the growth is examined to determine its attachments; and by this is meant not merely its natural attachments, but those due to adhesions. The contour of the growth is also estimated at the same time. If it be free from adhesions and movable, we at once ligate the round and upper border of the broad ligament, preferably outside the ovary; this secures the ovarian vessels. A second ligature or clamp is placed upon the upper border of the broad ligament at the cornua, which prevents escape of blood from the tumor when the ovarian vessels are cut. The same procedure is now carried out upon the opposite side. We now cut between the ligatures, or clamp and ligature if the former has been used, and thus free the upper part of the mass. If the upper part of the broad ligament be so short as to hold the tumor down firmly, we may

cut between the clamp and ligature upon the first side before attempting to ligate the second. Assuming that the growth is free from adhesions, we now deliver it. This is done by traction with a corkscrew or the volsellum, aided by compression of the abdominal surface above the fundus of the growth, or else by enlarging the incision and turning it out with the hand passed below it. If there be adhesions, these are carefully inspected, and as the tumor is raised they are separated by brushing them back with a sponge, or if too firm for this are separated

FIG. 338. FIG. 339.

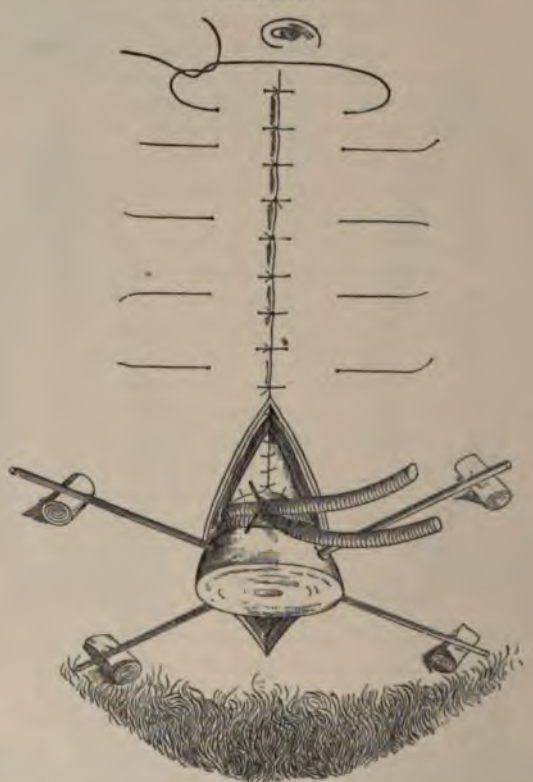


Hegar's ligation and extraperitoneal fixation of stump, with peritoneal attachment.

by cutting through the peritoneal covering of the tumor and peeling it off beneath the viscera which happen to be adherent. To prevent raw surfaces, the edges of such adhesions should be united upon the surface of involved viscera. If the adhesions are long enough to be severed without risk to the viscera, they can be ligated and cut away, and, if thin and fragile, need only to be torn away from the surface of the tumor either with the sponge or fingers. The mass being free and delivered, we lift it from the pelvis, so as to put its lower attachments

somewhat upon the stretch. We now examine the relations of the bladder to the anterior face of the growth. If natural, it need not be disturbed, but if it encroach upon the anterior face far above the cervical junction, it must be separated and pushed down. We then encircle the mass at or just above the cervix with an elastic ligature, which is then forcibly tied and cut short, the ends of this ligature being held together by a clamp so as to prevent the possibility of its becoming untied by retraction. Fixation-pins, one for each side, are now passed through the stump just above the ligature, but run obliquely from above downward,

FIG. 340.



Péan's extraperitoneal fixation of pedicle. (The elastic ligature is here substituted for the wire-loop and serre-nœud.)

one from right to left, the other from left to right, the two crossing each other in the centre of the stump. While these manœuvres are being executed an assistant guards the incision above, as in Cæsarean section, to prevent escape of the intestine. As soon as the pins are in place the tumor is cut away about half an inch above them and the stump is placed in the lower angle of the wound. The edges of the incision are now adjusted and united above by a double row of sutures, one for the peritoneum, another for the remainder of the wall. This form of union is carried out until the stump is reached (Figs. 338–340). As soon as the stump is reached an assistant draws it up with a volsellum fixed in its

face, and the operator carefully adjusts the peritoneum about it below the line of the ligature, and stitches the one to the other throughout the entire circumference, the line of the union being about one-fourth of an inch below the ligature. If the stump is large, it may be reduced in size by paring and cutting it down within the peritoneal covering above the ligature, care being taken to leave sufficient tissue to hold the transfixion-pins in place. As soon as the stump has been attached and adjusted plates are placed beneath the ends of the pins which now rest upon the surface to prevent them from cutting into the tissue beneath: the usual surface dressing is then applied. This closes the operation.

Returning now to certain complicating conditions which may present themselves, we find there are some which deserve more mention than we have given in the description of the operation. They are suppurative disease of the appendages, adhesions, and subperitoneal growths at the bottom of the mass. Pyosalpinx and a suppurating ovary are not uncommon complications, and always call for extra care in removal. They should be emptied by aspiration before removal is attempted, and this should be carried on with every possible aid to a clean operation. Full exposure is a necessity, and a painstaking enucleation or dissection. All of this should be done before any attempt at removal of the tumor is made.

We have called attention to the manner of dealing with the more usual adhesions, but there are cases in which, owing to oft-repeated attacks of peritonitis, the whole upper surface of the growth is covered with dense, firm, and very vascular adhesions, the tumor, in fact, being fed to a considerable extent by vessels from this source. Enucleation of the tumor from this capsule of adhesions is of course the only resource, and this can be done readily enough; but these adhesions may bleed inordinately and embarrass an operator greatly. Patience and alertness will prevail, however, and enable one to control by ligature an extent of bleeding surface which at first sight may seem prohibitive.

Tumors which project beneath the peritoneum at the base of the growth are of two general types. One is intraligamentous—that is, growing between the folds of the broad ligaments; the other springs either from the anterior or posterior face, beneath the reflection of the peritoneum, to the rectum behind or to the bladder in front. In this particular operation all are the more serious, in that they must be enucleated before a proper stump can be obtained. Those upon the lateral and posterior surfaces are the more troublesome, seeing that their connections bleed more freely. The course to be pursued is practically the same in all: the peritoneal covering must be opened and the tumor carefully enucleated; then, together with the entire mass, it is to be drawn up, so that the elastic ligature may be passed about the cervix below it. Fortunately, when once they are freed from this peritoneal capsule they can be so well uplifted that this ligature can be readily placed. This will control all bleeding from the side of the tumor, but not from its bed. Bleeding points must be sought out there and secured by separate ligature. The most serious condition, however, is when so many bleeding points are developed that there is oozing from pretty much the entire bed. If it comes from the bed of a posterior tumor, it is rarely extensive and generally yields to a firm packing of gauze, which may be left

in place while the stump is being adjusted and trimmed down, removing it just before closing the incision above, or else leaving it in, as with the Mikulicz drain, to be withdrawn the next day, the opening left above the stump to be then closed by tying the loose sutures, which should be placed at the time of the operation. If the bleeding surface be that left after the removal of a broad-ligament tumor, control is less easy. Fortunately, there is a ready method of accomplishing it, however, which the writer has found in one case to answer every expectation. Ligate the anterior trunk of the internal iliac. But, having done this much, it is as well to convert the operation into complete hysterectomy. Should drainage be deemed necessary in these cases, it should be made with gauze through the vagina by way of Douglas's pouch, a free opening being secured for this purpose. Some of these broad-ligament tumors are either independent of the uterus or else attached by a narrow pedicle; these may be successfully removed without sacrificing the uterus, but one may expect troublesome hemorrhage. It is to be treated upon the lines laid down above, and, should drainage be deemed necessary, it must be made through the vagina. In describing the method of ligating the stump in the extraperitoneal operation we mentioned only the rubber ligature. The serre-nœud end is preferred by some operators, but the ligature answers as good a purpose, is more simple, and requires less attention. The great objections to the extraperitoneal operation are the relatively slow convalescence, the opening left in the abdominal wall (both due to the stump), and the pain and shock due to tension upon the pedicle. The first and second can be minimized by reducing the bulk of the stump to the smallest possible proportions compatible with freedom from hemorrhage and security for the fixation-pins. The third and fourth can be obviated by securing a pedicle of sufficient length. But, spite of it all, a sloughing stump must be the result. The slough separates in from one to two weeks, leaving a granulating depression which gradually closes, giving always a weak spot in the abdominal wall.

The disadvantages of the extraperitoneal operation are so self-evident that the writer cannot but feel it will soon follow the paths already taken by the extraperitoneal method of treating the stump in ovariotomy. As far back as 1888[1] he endeavored to obviate some of its drawbacks by enucleating a stump in such manner as to provide a peritoneal envelope of sufficient length for easy attachment to the abdominal wall, the stump proper receding within this capsule to a point below the plane of the abdominal wall. In this way not only is traction upon the stump obviated, but by folding in the capsules at its attachments to the wall the smallest possible opening in this wall is obtained. Certain modifications were subsequently adopted,[2] but soon after, although the method had proved satisfactory in several cases, the writer abandoned it in favor of the complete method. Professor N. Senn of Chicago, no doubt misinformed as to this work, reported in the *Chicago Medical Record*, June, 1894, and later in his admirable work on *Tumors*, a similar operation as a new departure. Although the writer still regards it as inferior to complete extirpation, yet Senn's advocacy entitles it to consideration here.

[1] *American Journal of Obstetrics*, vol. xxi. p. 303.
[2] *Transactions American Gynecological Society*, 1890, vol. xv. pp. 137, 138.

It is performed in the following manner: Having delivered the tumor and ligated the ovarian vessels, round ligaments, and upper segments of the broad ligament, we next ligate the uterine vessels and the utero-sacral ligaments at the sides of the uterus; then make a circular incision through the outer covering of the tumor three or four inches above the cervix, and turn down the peritoneum in front, the peritoneum and vessels at the side, and the peritoneum and outer muscular coat posteriorly (Senn merely turns down the peritoneal covering). The collar thus created is deepened until we reach the base of the tumor (the cervix); then cut away the tumor at the lowest point of enucleation. After this secure any bleeding points that may appear. Senn excises a small strip of mucous membrane (the cervical) and approximates the cut surface with several rows of catgut. The writer burnt out the cervical canal with the cautery, so as to make a free opening into the vagina. The capsule, the envelope out of which the stump has been enucleated, is now stitched to the parietal peritoneum at the lower angle of the wound: its cavity is stuffed with gauze and the abdominal incision is closed about it. Senn removes this gauze on the second day, and the opening left in the abdominal wall by its withdrawal he closes by tying loose sutures which have been placed at the time of operation. The writer withdrew the gauze about the same period and suffered the small opening which remained, which was no larger than that left by an ordinary glass drainage-tube, to close by the natural shrinkage and granulation.

The Intraperitoneal Method.—Here also more or less of the cervix remains, constituting, in the writer's estimation, an objection to the procedure. It is carried out in the following manner: The steps of the operation are the same as for the extraperitoneal plan until the base of the tumor is reached; then, instead of encircling it with the rubber ligature, we proceed at once to the ligation of the uterine arteries at the side of the cervix. The utero-vesical fold of peritoneum is turned off from the uterus so as to expose the cervix anteriorly; pushing back this attachment laterally so as to displace outward the ureters, we introduce a strong ligature at the bottom and sides of the excavation thus created, and pass it from before backward close to the cervix beneath the uterine artery and utero-sacral ligament; then bring it forward above these structures so as to encircle them. This ligature is then firmly tied. The manœuvre is next repeated upon the opposite side, and the tumor is now cut away; we then seize the stump with the volsellum, draw it well up, and enucleate the entire supravaginal portion of the cervix; this leaves a cup-shaped depression, which is covered in by uniting the peritoneum attached to the bladder, previously removed from the anterior face of the lower segment of the uterus, to that upon the posterior face of the stump, such bleeding points as had been met with having been secured with catgut. The normal retraction of the tissue at the pelvic floor draws the pedicle down to a natural position. Should the cut edges of the broad ligament gape at the sides of the pelvis, they should be brought together with one or more stitches of catgut or silk. Some operators prefer to cut out the mucous lining of the cervical canal; others open it forcibly and drain through it. If the ovaries and tubes have not been removed in the original ligation of the ovarian vessels, they may now be taken off. Another mode of removing the uterus is

that already described in connection with abdominal hysterectomy for suppurative disease (Fig. 335). In both operations the abdominal wound is closed as after ovariotomy or complete hysterectomy, and the subsequent course and treatment are the same.

Complete hysterectomy, or, as some prefer to call it, *pan-hysterectomy*, is the ideal abdominal operation. It is as safe as any, and it not only permits complete closure of the abdominal incision, but eliminates the cervix entire, furnishing the best route for drainage, the open end of the vagina, and guarantees a better ultimate result. From his own standpoint the writer would never apply any of these operations to tumors that could be removed by way of the vagina. (See Vaginal Operation for limitations.) The operation is performed after the following plan: Pack the vagina forcibly with gauze, so as to fully distend and elongate it; then secure and sever the ovarian vessels, the round ligament, and the upper part of the broad ligament upon both sides, as already described in connection with other forms of abdominal hysterectomy. If the tumor is small as a whole, with a narrow, short pedicle—that is, with the lower segment approximating in dimensions the normal uterus—we can proceed to operate to the close upon the same lines as laid down for removal of the uterus by abdominal incision in suppurative disease (Figs. 331, 332, 333, 334). If the tumor is large, having a thick or elongated pedicle, we then make a departure from this method, as follows: Draw the tumor or stump to one side, open the base of the broad ligaments from the front, isolate and tie the uterine artery, taking special care to avoid the ureter. Now tie the tissues of the utero-sacral ligaments close to the uterus, and then enucleate the cervix, as in Fig. 333; then invert the structures as already described (Fig. 335) in connection with suppurative disease. After this we cleanse the peritoneum, close gapings of cut edges of the peritoneum, and sew up the abdominal incision. We now loosely pack the vagina with gauze, apply the abdominal dressings, give a stimulant nutrient enema, and place the patient in bed. In every case of hysterectomy the ovaries and tubes should be removed. Drainage should be omitted in all clean cases, but when made it should be by way of the vagina, as in vaginal hysterectomy. The retention catheter should then be employed. Cases complicated with a pelvic abscess must be drained in the same manner as pelvic abscess, the open abdominal method being employed if there be an extensive infecting surface.

The *after-treatment* of all cases of abdominal or vaginal section is much the same, no matter what may have been the condition for which it was undertaken. As a rule, the bowels should be moved on the third day, but sooner if there be temperature and distention. Salines and enemas generally suffice, but in obstinate cases small doses of calomel triturates of $\frac{1}{2}$ grain each every hour for six hours, to be followed by a saline, will be found useful. This measure can be still further aided by a full stimulating enema thrown high up into the bowel. If the stomach is quiet, fluid food may be commenced at the end of about twelve hours. In all cases involving much shock or exhaustion stimulants and fluid food should be given by the rectum at the close of the operation, and should be continued at intervals of from four to six hours according to the receptiveness of the bowel. This presupposes that the rectum has not been impaired during the operation. In abdominal cases morphine

is to be avoided, but it may be given in vaginal hysterectomy with little fear of harm, the patient possessing no special idiosyncrasy toward it. The abdominal stitches are removed about the eighth day, and the subsequent care of the case relates to the feeding, which should be simple but generous—to tonics, which should be selected with a view to blood-making and tissue-building properties, iron, quinine, and strychnia being the best.

The question of anæsthesia in these operations is of urgent importance. The writer prefers ether, and in vaginal hysterectomy, where less profound intoxication is needed than in the abdominal operation, he has found the conjoint administration of oxygen and ether after the Carson method invaluable: patients treated with this combination vomit less and react better and more quickly. He first obtains profound anæsthesia with ether alone, and then employs the combination. It fails in abdominal cases in general, because the anæsthesia is insufficient to ensure complete relaxation of the abdominal walls—a condition essential to these operations. He would add, finally, that in abdominal hysterectomy the Trendelenburg posture is of the greatest service, but he rarely resorts to it until the time arrives for dealing with the uterine arteries; then he considers it an essential.

Suture of the Abdominal Incision.—No better place than this can be found for mention of an appropriate method for closing the abdominal incision after any one of the suprapubic operations herein described. It is unfortunate that no one plan has yet been developed which commands universal acceptance. It is conceded, however, that the best results follow separate suturing of the important layers of the wall; it is a question of the material to be used. If catgut could be made sterile and yet absorbable—and upon this matter the writer is still a skeptic—that substance would be the best material for the deep or buried sutures. Many operators prefer silk, silkworm gut, or silver wire, but the writer, after using all of them, has adopted the following method, proposed by Dr. Geo. R. Fowler, by which he gains proper coaptation by means of an external suture only. The best silkworm gut seems to be the only substance fitted for the method. He passes the suture so that when in place it forms the figure of 8 in the tissue. This method has been in use elsewhere, and is known as the figure-of-8 suture. It is placed as follows: Beginning upon the left side, for instance, we pass first through the skin and fat in the order named, then across to the right side, where it passes downward through the fascia, muscle, and peritoneum, being entered at the fascia and muscle well back from the cut edge: emerging beneath the peritoneum near its cut edge, it enters at a corresponding point under the peritoneum of the left side, then through the muscle and fascia of this side, as already mentioned. The suture is then recrossed to the right, and is brought out through the fat and skin to the surface. If the subject is thin, the fascia may be included with the skin, instead of with the muscle and peritoneum as above described, but in fat subjects the arrangement should be as first mentioned. In excessively fat subjects it might be better to leave out the skin and fat, permitting them to close by granulation, applying the above suture only to the fascia, muscle, and peritoneum, including the fascia in the outer loop of the figure of 8, the muscle

and peritoneum in the inner. Upon drawing this suture tight the effect is virtually the same as a double row of sutures. The advantages possessed by the silkworm gut in this connection is not only its freedom from possibility of infection and subsequent mural abscess, but its strength, and above all the ease with which it can be withdrawn from this position. It can always be readily extracted—none other so readily.

This closes our article, and with it a subject we have endeavored to present as fully as space would permit. We believe we have given the essentials to a clear comprehension of the matter treated, but should any one be in need of further information, it may be had in most of the recent works devoted especially to obstetrics or gynecology. Differences will no doubt be found, but they relate mainly to matters of technique in operations, particularly in complete hysterectomy. The rendering given by the writer is based upon his personal experience, and it is offered for what it may be worth.

SURGICAL DISEASES OF THE OVARIES AND TUBES.

By JOSEPH TABER JOHNSON, M. D.

For a description of the minute anatomy, physiology, malformations, and histology of these organs readers are referred to other works, as the writer is limited in the space allotted to him to the purely surgical diseases of the uterine appendages.

Ovaritis consists in inflammation of one or both ovaries, and may be acute or chronic. In the acute form the surgeon is seldom called upon unless an abscess forms, requiring evacuation and removal, which will be described under the head of Pyosalpinx.

Chronic Ovaritis.—The great majority of these cases will be relieved without resorting to surgery. In a small number, however, in which enlargement occurs, accompanied by adhesions to the neighboring tissues, producing pain and otherwise incurable reflex nervous symptoms, the removal of the diseased ovary with its tube becomes a necessary and justifiable operation. Much has been suggested, and something accomplished, however, of late, in the conservative surgical treatment of these cases by which a portion of one ovary has been saved, its function preserved, the disagreeable symptoms of the menopause prevented, and childbearing has remained possible. When this can be safely done, there are many reasons why the mutilating and unsexing operation of complete removal should be modified by more conservative methods of relief. When, however, there occurs a reasonable doubt in the course of the operation that all the diseased portions of the ovary cannot be removed without sacrificing the entire organ, it should be unhesitatingly removed. Inasmuch as its accompanying tube is of no use after the ablation of the ovary, it should in all cases be removed also.

In fact, ovaritis seldom if ever exists without having been preceded and caused by salpingitis, making a separate consideration of the etiology of the various pelvic inflammations hardly possible, accepting as we do the very evident modern pathology of the inflammatory diseases of the female pelvic organs.

Endometritis, either septic or specific, in a great majority of cases causes the salpingitis, which in turn lights up an ovaritis, and this, spreading into the folds of the broad ligament, sets up a pelvic peritonitis, which may finally result in a general peritonitis. The grave and dangerous possibilities in this distressing class of cases constitute one of the most positive indications for radical, prompt, and thorough surgical relief. In that very small number of cases of puerperal origin where the pelvic infection arises from a lymphatic distribution of the poison the

cellular tissue about the uterus and under the peritoneum is first affected, the ovarian and tubal inflammations and the pus-collections being secondary. Experience demonstrates that this cause of pelvic inflammatory disease is a rare exception. Abscesses resulting from this cause occur underneath the peritoneum, only appearing in the pelvic cavity and involving the pelvic viscera after rupturing through the pelvic peritoneum. They are more difficult of cure than primary abscesses, requiring after evacuation constant irrigation and drainage until the infected cavities and areas are filled in by new and clean granulations.

Chronic inflammatory diseases of the ovaries, incurable by other means, require removal of the organs, in part or entirely, by a technique to be presently described. This operation becomes more difficult and dangerous than Battey's operation in proportion to the density and number of adhesions and the universal involvement of the tubes and broad ligaments.

OVARIAN ABSCESS.—Pelvic inflammatory diseases, resulting in pus-collections in the ovaries, are so identical with those in the Fallopian tubes in etiology, pathology, symptoms, and treatment that for description see Pyosalpinx.

PROLAPSE AND HERNIA OF THE OVARIES come under the attention of the surgeon only when the usual means for replacement and retention practised by the family physician have failed.

Causes.—The ovaries and tubes may be displaced in any direction, owing to their great mobility and the laxity of their supports. The direction of the displacement is governed by the nature and operation of the causative influence, whether they are carried up or down or farther to the right or left side. Thus they may drop downward from acquired increase in size and weight, from diseased processes, or be carried out of position by the varied changes in the position of the uterus to which they are attached. The ovaries and tubes may form a part of an inguinal, femoral, labial, ventral, or umbilical hernia, and they were found by Kiwisch in the foramen ovale in one case.

The **symptoms** will vary according to the cause of the displacement and the location of the ovary. Pressure causes a faint, sickening sensation, and is produced with more frequency and severity when the ovary is prolapsed in Douglas's cul-de-sac, where it is often squeezed between the retroverted fundus uteri and a rectum loaded with hardened fæces. Coitus is painful, and numerous reflex symptoms torment the patient. Whenever the ovary becomes adherent to the surrounding tissues these symptoms are all intensified, and pains extend into the ischio-rectal fossa and down the leg of the affected side.

Diagnosis.—The diagnosis is readily made by digital manipulation, the educated sense of touch revealing the abnormally located ovary, aided by the sickening sensation complained of by the patient when the ovary is pressed upon. Scybala in the rectum might be mistaken for a prolapsed ovary, but when it is remembered that these are not painful and are frequently multiple, this error should not occur.

The surgical **treatment** of dislocated ovaries and their accompanying tubes consists simply in their removal. This, however, should never be done until after all other means have been faithfully and skilfully tried, and have failed, and not then unless the patient's life, health, or reason

is seriously threatened. Oöphorectomy for this purpose could be performed with less shock and risk by the vaginal than by the abdominal route. Byford of Chicago and Jacobs of Brussels recommend it—the former only in non-adherent cases, the latter in adherent pus-tubes and ovarian abscesses as well.

The vagina having been made aseptic, an opening is made posteriorly through Douglas's pouch or by anterior colpotomy, so as to avoid the ureters and the uterine arteries, the ovaries and tubes are found and hooked down into the opening, transfixed as in oöphorectomy, ligated, and cut off. If there is no hemorrhage or pus, the peritoneal and vaginal

FIG. 341.

Double dermoid cysts, removed during pregnancy; recovery (Mundé).

opening should be separately closed. If irrigation is required, it can easily be practised and the opening only partially closed. A gauze drain should then be left in until the discharge ceases, when it should be removed, and the opening will close of itself in a few days.

OVARIAN TUMORS.—For a description of the minute anatomy, microscopical appearances of the walls, coverings, lining membranes, and contents of the numerous abnormal growths of the ovaries, tubes, and broad ligaments, readers are referred to works dealing with these special subjects.

Ovarian tumors, clinically speaking, are either fluid or solid. The fluid or cystic varieties include the simple, proliferating, and dermoid cysts. Solid tumors may be of the fibroid, sarcomatous, or carcinomatous varieties, and occur much less frequently than cystic growths. Cystic tumors may develop from almost any point or structure in or about the ovary and tube, and also in the folds of the broad ligament.

Practically, the surgeon finds for removal tubo-ovarian cysts, parovarian, and ovarian tumors, as well as those developing from the organ of Rosenmüller, the hydatid of Morgagni, and the duct of Müller.

These cysts may be unilocular, multilocular, glandular, or papillary, proliferating, follicular, dermoid, and parovarian. They may attain any size, weighing from an ounce to one hundred pounds. True ovarian cysts of the glandular and proliferating varieties constitute the largest

tumors. The contents of the smaller tumors are mostly a clear watery fluid, except the dermoid, which contains skin, hair, fat, thick sebaceous matter, plates of bone, and teeth. Large multilocular cysts frequently contain fluids of all colors and varieties of density. One compartment of the tumor may contain clear fluid, like spring water, while in another the contents may be brown, green, or black, and be too thick to run through a large cannula. Ovarian tumors may be of a mixed character, partly fluid and partly solid.

Tubo-ovarian cysts may communicate with the uterine cavity through the patulous tube, and a large tumor be prevented by the gradual evacuation of the fluid contents through the uterus and vagina, thus constituting the condition known as a profluent ovarian hydrops, which under an erroneous diagnosis has been described as uterine hydramnia.

Solid Tumors.—These occur in about 5 per cent. of the cases requiring operation in the varieties known as fibromata, sarcomata, and carcinomata.

Fibroid or *myomatous* growths of the ovary are rare, seldom or never attaining large size, though Doran has reported a case where an ovarian fibroid weighed seventeen pounds, and Bland Sutton another of fifteen pounds and two ounces. The writer, out of more than three hundred ovarian operations, has met with but one true fibroid tumor of the ovary, which weighed a little over four pounds, and was successfully removed from an old lady sixty-seven years of age. It is now in the Army Medical Museum at Washington.

Sarcomata.—Sarcomata generally grow from both ovaries at the same time. Many of the solid tumors of the ovary are of this class. Their rapid growth is characteristic and often suggests the diagnosis.

Carcinomata are generally secondary developments or degenerations of primarily existing cystomata or adenomata. Ovarian cancer is said to occur in 50 per cent. of the cases simultaneously on both sides.

Etiology.—Very little is definitely known as to the causation of ovarian tumors. They occur from infancy to old age.

The childbearing age has been supposed to cover the period when they were most frequent, but, while this may be true, recent papers by Taber Johnson and Howard Kelly report about one hundred and fifty ovariotomies in women between sixty-seven and eighty-one years of age. Bland Sutton has recently collected 60 cases in children under fifteen years of age, 23 of which were dermoid, 16 ovarian cysts, and 16 sarcomata. Relatively, they occur more frequently in single and childless married women than in multiparæ. Chlorosis, family tendency, and sterility are also named as causes.

Symptoms.—The first symptoms which attract attention are generally those arising from the effects of pressure upon the pelvic viscera, chiefly the bladder and rectum, causing frequent and sometimes painful desire to evacuate these organs; also an increasing sense of weight and pressure in the pelvis, causing œdema of the vulva and lower extremities, which increases to such an extent in certain dermoid, intraligamentous, or bound-down varieties of tumors as to demand removal while they are still comparatively small.

As the tumor increases in size the abdominal and thoracic viscera are more or less interfered with, and attacks of pain from direct pressure

and consequent indigestion are frequent, and so interfere with the process of digestion and nutrition as to produce a gradual and characteristic

FIG. 342.

Facial expression of patient with ovarian tumor (*facies ovariana*).

emaciation, also causing difficult breathing and interference with the action of the heart.

Pain may be caused by adhesions to the various organs compressed and by circumscribed attacks of peritonitis.

The menstrual function may or may not be interfered with. Too frequent and too free loss of blood occurs in some cases, suggesting a

FIG. 343.

Facial expression of patient with ascites.

diagnosis of uterine fibroma, while just the opposite condition exists in others, confusing the diagnosis with that of pregnancy. While sterility is the rule, pregnancy and ovarian tumors not infrequently coexist. Mundé has reported six successful ovariotomies on pregnant women.

Pressure-symptoms.—These are more serious when the tumors affect the kidneys, causing albuminuria and dilatation of the ureters from me-

chanical interference, at times amounting to a hydronephrosis or to temporary suppression of urine.

All of these symptoms are not always present. Indeed, women have carried large tumors for months without troublesome symptoms of any kind, only complaining of their tight clothing and the weight they were carrying about. When, however, the stomach and diaphragm begin to suffer from the size and upward pressure of large tumors, symptoms of marasmus arise, nausea and vomiting occur, the desire for food is lost, the tongue becomes brown and dry, the facies ovariana is rapidly developed, and the patient from this time on, unless saved by ovariotomy, rapidly declines in flesh and strength, the process involving nearly every tissue and organ of the body in general ruin and decay of function, until she dies a painful and miserable death.

The **physical signs** are made out by—1st, inspection; 2d, palpation; 3d, percussion; 4th, auscultation.

The rate of growth of the tumor is determined by mensuration. For a correct appreciation of these signs the patient should be properly prepared—that is, she should be undressed, in bed, with an empty bladder and rectum. The abdomen being exposed to view, the following points can be gained by inspection: the size of the tumor; whether it occupies a central position or grows mostly on one side; whether it is smooth or nodular, indicating its unilocular or multilocular variety; solidity or fluidity, cystic or free fluid collection; fibroma or pregnancy. The color and general appearance of the skin may suggest pregnancy or previous treatment for pain and peritonitis.

FIG. 344.

Showing emaciation of a patient, aged fifty-three, from whom an ovarian tumor weighing sixty-seven pounds, was successfully removed October, 1894.

Palpation is made by one or both hands over the abdomen, determining the presence of a tumor, its location, whether it be fluid or solid, irregular in outline or smooth, cystic or free, or sensitive to the touch. Bimanual palpation will detect the degree of fluctuation. Thick-walled cysts, fat abdominal walls, colloid contents, or many compartments to a cystoma will prevent the wave of fluctuation from being so distinctly felt as in a unilocular cyst.

Percussion aids in locating the growth, in determining which organ in the abdominal cavity is diseased, its nature and extent, and in differentiating all abdominal neoplasms from gaseous collections. The neglect of this means of diagnosis has resulted in accidents fatal alike to the innocent patient and the reputation of the bungling surgeon. The his-

tory of ovariotomy discloses the sad error of mistaking phantom for ovarian tumors.

Auscultation is of especial value in the detection of pregnancy alone or coexisting with ovarian tumors.

Cause, Duration, and Termination.—Fully 80 per cent. of women having ovarian tumors unrelieved by surgery die within four years from the origin of the tumor; a majority die within three years. Of the remaining 20 per cent., some die earlier from accidental causes and complications, such as rupture, hemorrhage, torsion of the pedicle, obstruction of the bowels, pressure upon the ureters involving the kidneys, peritonitis, etc., while a few live a varying number of years, from five to twenty. The character of the tumor determines, to some extent, the rapidity of its growth. Fibro-myomata, dermoid and broad-ligament cysts are of much slower growth than the proliferating and glandular varieties. Intraligamentous cysts are not of a rapid growth as a rule; neither are the papillary cystomata. These cysts after tapping rapidly refill; thus within seven years one of these tumors was tapped one hundred and five times. The writer tapped an old lady, upon whom he afterward successfully operated, nine times within a period of eighteen months, drawing off between forty and fifty pounds of fluid each time. Recovery has resulted from ruptures of simple cysts containing a bland and unirritating fluid, also from a single tapping of parovarian cysts. This fortunate result cannot be expected from the other varieties. These patients all die a lingering death, worn out by the pressure and complications of the tumor, unless rescued by the surgeon. The earlier ovariotomy is resorted to after the diagnosis is made the less the woman will be compelled to suffer, and her safe and complete restoration to health will be greatly accelerated.

Patients allowed to drift along without surgical aid or subjected for months to useless medical treatment may suffer untold misery from constant and increasing interference with the abdominal, often the thoracic, and usually the pelvic, viscera. Death may occur suddenly from rupture, peritonitis, twisted pedicle, or involvement of kidneys or bowels. Ascites may develop or malignant degeneration occur, and aid in pushing the patient more rapidly toward a fatal issue, or greatly complicate and jeopardize what might otherwise have been a comparatively safe and easy operation.

Complications may arise from accidental changes in the cyst itself, also from its interference with the functions of the heart, lungs, kidneys, bowels, etc.

Rupture of the cyst is sometimes produced by falls, blows, or other accidents, or may be due to changes which slowly take place in the cyst-walls. As the tumor grows larger, its wall becomes thinner or it may ulcerate through into the bowels, bladder, or peritoneum. The character of the fluid generally determines the result. If non-irritating, no harm follows, and the patient possibly may be spontaneously cured by the discharge and absorption of the fluid. If the ruptured cysts contain pus, colloid material, or the decomposing fat of a dermoid, peritonitis and death are almost certain to occur. One case has occurred in the experience of the writer where rupture took place externally at the navel. Should rupture occur into the intestines, bladder, or vagina, the slow

diminution in the size of the tumor and the unexpected discharge of large amounts of fluid would at once determine the location and nature of the accident. If into the peritoneum, the disappearance of a cystic tumor and the sudden appearance of free fluid in the abdominal cavity, together with the accompanying symptoms, would reveal what had happened.

Twisting of the pedicle occurs slowly, as a rule, and at first produces but few symptoms. The tumor gradually increases in size where sudden rotation occurs, especially if more than one twist exists and the neck of the tumor is strangulated, when symptoms of peritonitis rapidly supervene, causing the death of the patient unless she is saved by an immediate operation. The danger is much in proportion to the extent of strangulation. There may be anywhere from one to a dozen complete twists. The tumor may be suddenly increased in size from rupture of distended veins and hemorrhage into the cyst.

The **diagnosis** in most of the reported cases was not made until the actual condition became apparent at an operation done hurriedly to save the patient's life. Pain, vomiting, distention, rapid pulse, all indicate a grave condition, and should these symptoms come on suddenly in a patient having an ovarian tumor, axial rotation may with much certainty be diagnosed.

Rupture of a distended Fallopian tube might simulate twisted pedicle, but as the treatment would be the same in both cases, little harm would be done by an error in diagnosis. Where torsion is gradual or chronic the symptoms are slow or in proportion to the amount of strangulation. In long pedicles and where no adhesions have formed the tumor may rotate back again, thus untwisting the twist, and this alarming condition be spontaneously cured.

Speedy operation is the only known remedy for twisted pedicle. Unless relieved in time these tumors, having their blood-supply cut off, become gangrenous, rupture, and set up a rapidly fatal peritonitis.

Hemorrhage into the cyst may be caused by accidental injury, torsion of the pedicle, puncture of a vessel during tapping, or by congestion and inflammation of the cyst-wall, producing over-distention and rupture of its vessels.

The damage to the patient is serious in proportion to the amount of the bleeding. Slight hemorrhages do little harm, while the amount of blood discharged may be such as to produce collapse and require immediate operation to save the patient's life.

Inflammation and suppuration of the wall of an ovarian tumor may only cause slight pain, tenderness, and fever, but when the trouble is caused by infection from a septic Fallopian tube or from an unclean trocar used in tapping the tumor, from adhesion of intestines and the admission of gases, or from a suppurating dermoid, the symptoms are all intensified. Especially distressing are the symptoms when caused by discharge of the contents of a dermoid into the bladder or rectum, as pieces of bone, fat, teeth, and locks of hair irritate the bladder and are liable to block up the urethra or intestine. These conditions, when diagnosed, should be relieved at once by careful operations. Rents in the intestines or bladder are quite likely to occur when separating strong adhesions, and require skilful suturing to successfully close them. A

little more time spent in thorough and complete work here would save more lives and redound to the credit of surgery.

Ascites.—It was formerly taught that an accumulation of ascitic fluid in the abdominal cavity, coexisting with ovarian tumor, was a pretty sure indication of malignancy. It is now known to result also from torsion of the pedicle, chronic peritonitis, rupture of the cyst, and hydronephrosis.

Ovarian tumors of the papillary variety are nearly always surrounded by a collection of ascitic fluid. When the quantity of fluid is not great, it is of actual benefit in preventing adhesions and may render the removal of the tumor easier. Larger collections add to the pressure-symptoms already existing.

Ascites usually is present with fibromata and sarcomata as well as with carcinomata.

Intestinal obstruction may be a rapidly fatal complication of large ovarian tumors. It may be caused by inflammatory bands, long twisted pedicle, or by direct pressure.

The sudden collapse of a tapped ovarian tumor may drag adherent intestines into a condition resulting in obstruction, or adhesion may take place to an empty punctured cyst. Twisting or volvulus may subsequently occur. Malignancy may extend from an ovarian tumor so as to implicate and fatally obstruct the intestines.

Diagnosis.—The earlier literature of abdominal surgery is so marred with instructive records of errors of diagnosis that it would be fair and reasonable to expect in this later day of wonderful achievements that such a degree of proficiency should have been reached as to make a clear mistake wellnigh impossible; but such, unfortunately, is not the case. We read accounts of operations almost daily in medical journals in which one form of abdominal growth has been mistaken for another. Soft uterine myomas are mistaken for ovarian tumors, and *vice versâ*. Thick-walled, non-fluctuating ovarian tumors are diagnosed as fibromata, while fibroids in their turn are mistaken for pregnancy. Operations are still reported which were begun as a hysterectomy and terminated as a Porro or Cæsarean section.

Painful dermoids are diagnosed as extra-uterine pregnancy, and small ovarian tumors for retroverted uterus, pyosalpinx, ovarian abscess, or impacted fæces. Large cystomata have been treated for ascites, while ovariotomy has been attempted for hydronephrosis, hydatids of the liver, and phantom tumors.

In describing the differential diagnosis of ovarian tumors it is usual to divide the subject into small and large tumors or into pelvic and abdominal tumors.

Pelvic Tumors.—It is a good rule for a beginner in examining a patient for suspected ovarian tumor, as in obstetrics, to go over in his mind the chief points of differential diagnosis between the growth or presentation thought to be present and every other growth or presentation which might possibly be present. In this way one early contracts the habit of differential diagnosis. More mistakes are made from haste or carelessness than from ignorance.

After determining the existence of a tumor, the next question which arises is, Is it ovarian, or may it be something else? Does it contain

fluid? Can it be a distended Fallopian tube, or a broad-ligament cyst, or the result of pelvic inflammatory disease, hæmatocele, retroverted uterus enlarged from pregnancy, or extra-uterine pregnancy? Is it a solid tumor of the ovary or uterus?

In answering these questions there is little chance of overlooking evidence which might point out the exact nature of the growth. The previous history of the case usually throws much light on the diagnosis: thus, one would not find the results of inflammatory disease unless there had been a previous inflammation accompanied by pain and fever, or a salpingitis or pyosalpinx without the history of an endometritis, probably septic.

Extra-uterine or normal pregnancy would not exist before puberty or after the menopause, or without the presence of some of the signs of gestation.

Solid tumors of the uterus are differentiated by their hardness, painlessness, or intimate connection with that organ, causing, as a rule, displacement and more or less hemorrhage; while in small, solid ovarian tumors the uterus is rarely diseased or displaced except as it may be pushed out of position by the enlarging tumor.

Large or abdominal tumors should be differentiated from the following tumors in the abdominal cavity:

Pregnancy.—The history of the enlargement will be of great service in forming an opinion. Certainly, some of the signs of pregnancy must be present, such as suppression of the menses, digestive irregularities, discoloration of the vulva, softening of the cervix, and later on fœtal movements and heart-sounds, etc. In pregnancy the enlargement would be uterine and continuous with the cervix. In ovarian tumor the enlarged uterus can generally be made out with one hand above the pelvis and the examining finger in the vagina or rectum, using an anæsthetic if necessary.

Hydramnios may lead to error of diagnosis, but surely some sign or history of the pregnancy will be found if looked for. In all cases of mistaken diagnosis known to the writer the operator has admitted that signs had existed, but to which he had not attached the proper significance or which he had overlooked altogether.

In case of great distention the cervix will, as a rule, be sufficiently open to permit the examining finger to feel some portion of the fœtus, even if it be dead.

Pregnancy may coexist with ovarian tumor, in which case one has to decide, when the enlargement is very great, whether to perform ovariotomy or induce premature labor.

If the child is alive, ovariotomy is, as a rule, the better and safer operation. Collections of air, water, or blood in the uterus may also confuse a diagnosis, but careful bimanual examination, together with the previous history, should clear up the case.

Fibroid and fibro-cystic tumors of the uterus are sometimes exceedingly difficult to differentiate. In case of a small fibroid the hard nodular, movable mass, connected directly with the uterus, with symptoms such as irregular discharges of bloody and watery fluids, would indicate its nature. Fibro-cystic tumors are much longer acquiring a large growth: they are rare, they form a continuous mass with the uterus,

and have hard masses upon them easily made out. They produce less constitutional disturbance, and rarely occur in a patient under thirty years of age. The fluid from a fibro-cyst coagulates entirely when withdrawn and exposed to the air.

Ascites.—The abdominal cavity well filled with ascitic fluid resembles, upon inspection, a unilocular ovarian tumor, but when other means of diagnosis are applied the error should be corrected. Percussion at once reveals the fact that the intestines float on top of the fluid, and that upon depression of the abdominal wall no tumor is found. The fluid gravitates to the flanks, and these regions are not resonant. A dull, flat percussion-note is produced with the patient in the recumbent position. In changing her position the tympanitic resonance changes place. If the fluids be confined within the limits of a cyst, these changes in the location of the fluid, the floating of the intestines to the top, and the changing percussion-notes will not occur. In ovarian tumor we find dulness over the distended area, resonance above and to one side. In cases of great distention the mesenteric attachment of the intestines prevents their floating to the surface. In ascites, with the patient on her back, by depressing the abdominal wall percussion will reveal resonance.

The history of the case should indicate in ascites disease of the heart, liver, or kidneys. As a result of one of these conditions the accumulations take place in a few months, while, as a rule, an ovarian tumor to have acquired such great size would have taken from one to three years.

A solid tumor will be indicated by greater resistance. Small solid ovarian tumors and uterine fibromata with long pedicles sometimes coexist with ascites, and may even cause it by irritation of the peritoneum. It is well to suspect malignancy when ascites coexists with ovarian tumor. The uterus is movable in ascites, while an ovarian tumor is likely to crowd it up against or just above the pubis or to one side. It is impossible to move it about, as in ascites.

Encysted ascitic fluid has been mistaken for ovarian tumor, and the error only discovered at the operation. Howard of Baltimore has reported two such cases. When the fluid was let out the hand could be passed into an enormous cavity containing absolutely nothing, the abdominal viscera being all shut off by the walls resulting from an inflammatory process.

Tuberculosis of the peritoneum may cause collections of free fluid, also a tumor, by agglutinating together coils of intestines and omentum. This disease occurs, however, more frequently in the young, and is usually accompanied by evidence of tuberculous disease in the lungs or some other part. Tenderness over the intestines upon pressure and an evening rise of temperature ought to aid much toward clearing up a diagnosis.

Phantom tumor may distend the abdomen to a great extent. These cases have been diagnosed ovarian tumor, also as pregnancy. They occur mostly in the nervous and hysterical class of women, whose ungoverned imagination leads them astray. An anæsthetic will relax the spasmodic contraction of the abdominal muscles, when the tumor completely disappears. Percussion will settle the fact, however, that the supposed tumor contains nothing but wind.

There are twenty or thirty other kinds of enlargement which may

take place in the abdominal wall or abdominal cavity which might, if one were very hasty and careless, be mistaken for ovarian tumor, but the prudent and reasonable exercise of the ordinary means of differential diagnosis should keep any cautious and conscientious surgeon from these mistakes. Operations should not be undertaken upon a snap judgment, unless great urgency exists caused by a twisted pedicle or sudden rupture of a cyst, producing hemorrhage or peritonitis. Time should be taken to become familiar with the entire mental and physical state of the patient. Repeated examinations, quietly made when in doubt, throw much added light on the case. Nervous and frightened patients, when first examined by the consulting surgeon, often forget or misinterpret important facts in the history of the case, which may be cleared up and receive their proper valuation when in the quiet of her room or in a hospital. With these increased opportunities for acquiring exact information, obesity, ventral hernia, tympanitis, fecal accumulations, desmoid tumors, distended bladder, enlargements of the liver, spleen, or kidneys ought not to be mistaken for ovarian tumors. More doubt will exist, however, where omental, kidney, spleen, pancreas, or liver-cysts are present. Careful study of the previous history of these tumors, together with the fact that they grow from above downward, giving flat percussion-notes above and leaving the abdomen resonant near the pubes, contrary to the facts when the growth is ovarian, should prevent error.

The tumor having been diagnosed as ovarian, it will be interesting and important to settle the question as to whether it be unilocular or multilocular or of the dermoid variety, and if it be free or bound down by adhesions.

The wave of fluctuation in a unilocular cyst is unobstructed, and can be plainly felt by one hand on the side of the tumor while a slight tap is made with the other hand on the opposite side. The walls of separation in a multilocular tumor prevent the percussion impulse from extending through to the opposite side. These tumors grow more rapidly than a single cyst, and when the compartments are numerous and small it is very difficult, if not impossible, to determine whether we are dealing with a soft myoma or a multilocular ovarian tumor.

The diagnosis may not be certain until an exploratory incision reveals the true nature of the case. Dermoids are of slow growth, never attain great size—are more movable, and, being more dense, no fluctuation can be felt. It may be expected that we will find adhesions where inflammations have occurred and also from the long-continued pressure of very large tumors.

The most frequent location for adhesions is the anterior abdominal wall, next the omentum. The most dangerous adhesions are to the intestines and bladder. The most difficult to manage are those deep down in the pelvis. One cannot be positive whether adhesions exist or not, but if the abdominal walls are movable over the tumor, and the tumor itself can be pushed about to some extent, they are not supposed to be present. The most dangerous intestinal adhesions are not incompatible with considerable mobility, as they move with the tumor.

Exploratory Puncture.—When there still remains considerable doubt as to the nature of the tumor, it was more the custom formerly than it

is now to withdraw some of the fluid for chemical and microscopical examination. As the danger of this procedure far exceeds any advantage which might be gained by this analysis, it is a practice which should be more honored in its breach than in its observance. The writer has never yet had or seen a report from a microscopist where he was so sure of his diagnosis that he would positively say in his report to the surgeon, This is or is not a case for operation. What is the use of exposing the woman to positive dangers to obtain a report which will not be of the slightest use when you get it? The microscopist will not divide the responsibility with the surgeon, who has to bear it all.

The dangers of exploratory puncture and tapping the tumor for the withdrawal of all the fluid obtainable are about the same. In the latter case, however, some good has accidentally resulted in rare cases, a permanent cure being established by the tapping of a parovarian cyst or large hydrosalpinx.

These dangers are—internal hemorrhage from injured blood-vessels; fatal peritonitis, caused by punctured bladder or intestines and escape of contents. Air may be admitted to the cyst and set up decomposition of remaining fluid and septicæmia, or irritating fluid from the cyst may escape into the abdominal cavity, causing peritonitis, adhesions, and possibly death of the patient. The same result is more slowly, but just as surely, brought about when fluid from papillary, malignant, or echinococcus cysts leaks from the punctured opening in the cyst-wall into and infects the abdominal cavity.

In view of these facts, exploratory incision is to be recommended, instead of puncture or tapping, in those cases where the nature of the tumor still remains doubtful after applying all the means of diagnosis above referred to.

Exploratory incisions, when required to perfect a diagnosis, should be made with the same antiseptic and other preparations which are usual for laparotomy, and only by those who are able, as well as prepared, to complete whatever operation is found to be necessary and best for the patient. A small or buttonhole incision—and not one four or five inches long, as we sometimes see—having been properly made, one or at most two fingers are introduced and gently passed in all directions possible, and the actual condition determined. Should the case not be one for operation, less harm has been done than by a blind tapping, while, in addition to the evacuation of the fluid, a diagnosis has been completely and satisfactorily made out.

The writer cannot resist the temptation to sound a note of warning in the ears of beginners in this field of work. He has seen trouble come, and in one instance death, from carrying an exploration too far.

It is well to remember that exploratory operations should simply explore. Should vascular adhesions be broken into, it may require the ligation of vessels or the removal of the tumor to arrest hemorrhage which should never have been produced, and that when one may be unprepared or unable to perform such an extensive operation.

Many cancerous tumors are difficult to diagnose and more difficult to safely explore. The natural dread of leaving a trusting woman to her sure and horrid fate leads on the ambitious or reckless surgeon to try his hand at the impossible, by which he precipitates, instead of arresting,

her impending fate. Malignant ovarian tumors have been safely removed, no doubt, but not after they have infected surrounding tissues and formed the most vascular of adhesions, the breaking up of which is sure death.

While precision in diagnosis of abdominal diseases and tumors should be aimed at, there are cases, it is squarely admitted, where precision is simply impossible by any known and safe means.

Repeated and prolonged manipulative examinations of delicate and suffering patients by many consulting surgeons and physicians are all wrong. If she is not frightened to death, peritonitis or rupture of a cyst may be produced. If the surgeon can become thoroughly satisfied that the patient is suffering from one of half a dozen conditions, any one of which is liable to prove fatal if left to itself, he is justified in going ahead.

Under some of these circumstances precision in diagnosis is neither possible nor necessary. What difference does it make, when a woman is drifting upon the breakers and probable destruction, whether she is in a boat labelled ruptured tubal pregnancy, suppurating dermoid, ruptured or leaking pus-tubes, ovarian abscess, or suppurating appendicitis? When a good surgeon conscientiously believes one of these conditions to exist, and that the patient will remain an invalid or die if not relieved, and, further, if this were his wife or sister he would still recommend an operation, he should go ahead and operate, whether he knows exactly what is the matter or not. He can safely find out as he proceeds if he understands his business. He needs only to be sure that something abnormal is there which is destroying her health or her life.

Goodell has reported a case where, with the mass in his hands after the operation was safely over, he could not decide exactly what he had removed. He knew the mass did not belong in the patient's abdomen, and he knew that it was wrecking her health and was likely to destroy her life, and he went ahead and removed it; and he did right. Abdominal surgery is the place, above all others, where the motto applies, "Be sure you are right, then go ahead—without delay."

Treatment.—Nothing is to be expected from the administration of drugs or from external applications to ovarian tumors. As the fluid is enclosed within a sac which has the power to secrete an unending quantity, counter-irritants cannot lessen it and tapping only temporarily removes it. The withdrawal of the cyst-contents is quickly followed by its reaccumulation, and the process, repeated frequently, exposes the patient to many dangers in addition to the exhaustion from the loss of so much albumin. Tapping may be resorted to, to save time, when a patient has come from a distance, is exhausted by the fatigue of her journey, and the heart, lungs, and kidneys are greatly oppressed by the size of the tumor. The surgeon should, however, hold himself constantly ready to operate should any symptoms of peritonitis or internal hemorrhage arise.

Another exception to the rule, "It is a surgical crime to tap an ovarian tumor," may be noted in cases of pregnancy, when the patient or physician opposes the removal of the tumor, labor being near at hand or in progress. Small ovarian tumors, filling the pelvis and opposing the advance or delivery of the fœtal head, may be punctured through the vagina after rendering it aseptic.

The promises held out by the advocates of electrolysis have not been fulfilled. The only treatment which offers any chance of life to the doomed woman is purely surgical.

OVARIOTOMY.—This operation was first performed by Dr. Ephraim McDowell in the year 1809 in Danville, Kentucky, upon Mrs. Marian Crawford, before the days of anæsthesia. The operation was successful, she living thirty-eight years afterward. It established his reputation upon an imperishable foundation, and has been the direct means of saving thousands of valuable lives, not only in this country, but throughout the world. McDowell performed 13 ovariotomies, with 6 deaths.

It was more than half a century before much better statistics were presented. Gradually, one able and independent operator after another worked out better methods, until the mortality was so greatly reduced that now the removal of ovarian tumors has been made one of the most, if not the most, successful capital operations of modern times. In the evolution of ovariotomy many sad lessons have been learned.

The rules to be followed to secure an average mortality of only 2 or 5 per cent. are quite arbitrary, and he who departs from them with bad results has to show very good cause to escape censure. The various steps of the operation may be stated as follows:

1st. The preparation of the patient.
2d. " " of the operating-room.
3d. " " of the operator and his assistants.
4th. " " of the nurse.
5th. " " of the instruments, sponges, and dressing.
6th. Anæsthesia.
7th. The operation itself.
8th. The after-treatment.
9th. Complications.
10th. Accidents.

Preparation of Patient.—If she has arrived from a long journey, quiet and rest for a few days are advisable. A day should be fixed for the operation. The skin should be prepared by frequent bathing and friction, special care being given to the navel and the external genitals. The night before and morning of the operation the vagina should be thoroughly washed out with a 1:2000 solution of corrosive sublimate. The diet for at least two days, better for a week, should be bland, fluid, and nourishing; the bowels should be thoroughly emptied by purgatives, taken night and morning for two or three days. The more empty the bowels the less they will trouble the surgeon during the operation and the patient after etherization by nausea and wind colic during the first days of convalescence.

Should the patient not be nervous or alarmed by all these preparations, the abdomen and mons Veneris may be shaved and the abdomen covered with a pad soaked in a bichloride solution for several hours preceding the operation.

Some surgeons prefer to operate with the patient's bladder full of urine, that they may easier locate and avoid injuring it. Others direct that it should be completely emptied with a catheter: whichever is the case, the surgeon should be informed by the nurse.

Preparation of the Operator, his Assistants, and Nurses.—They

should make themselves surgically clean. This is more essential in abdominal than other surgery, as no chemical antiseptics of sufficient strength to do any good are allowable within the peritoneal cavity.

An authority in this country has said that "one's mortality in abdominal surgery is governed more by what he puts into the peritoneal cavity than by what he takes out of it." The same great and good man said also that in obstetrics, as well as abdominal surgery, "many a woman has had her death-warrant concealed under her doctor's fingernails."

After making themselves surgically clean, the operator, his assistants, and nurses should aim to remain so during the operation. The most perfect preparation in this respect is often spoiled by handling non-sterilized objects, lifting the patient from her bed to the operating table, passing a catheter, hunting for a forgotten but needed instrument in an unsterilized bag, scratching one's head or nose, or shaking hands with distinguished visitors. After any of these "slips in the technique" the hands should be rendered aseptic again. It is better, though not essential, that time should be taken to change the street clothing for a clean white suit of some washable material. The patient is thus protected from a possible source of contamination, and the operator, his assistants, and nurses are more comfortable during the operation. By changing their clothes and drying the skin by a good rub many a rheumatism and bronchitis is prevented, as surgeons drive in their buggies from house to house afterward.

Nurses should wash their hair, and if they are menstruating a fluid with a bad odor or nursing patients ill with any septic or infectious disease, they should not come into the operating-room at all.

Preparation of the Room.—The modern tiled or marble operating-room is not essential to success, though it is better. Any room admitting sufficient light can be made clean for the moment of the operation. In a private house the room selected should have a northern light, and should be prepared for the operation by taking everything out of it, the floor thoroughly cleaned with a sublimate solution, walls and woodwork wiped down with the same. An operating table and tables for basins of water and for the instruments can easily be procured in the house, made surgically clean, and conveniently arranged by taking the necessary time and care.

The perfect appointments of the operating-room of the modern private hospital, so frequently illustrated and described of late, possibly combine all the facilities for successful abdominal surgery better than large general hospitals or private houses. Next in point of safety is the private house with an environment made aseptic for the occasion, and last the general hospital. A surgeon having the most perfect facilities and devoting himself largely or exclusively to abdominal surgery, as his experience increases ought to acquire greater skill in this particular field of work and to have greater success than the occasional operator, who does also a large general, surgical, or obstetric practice. Although antiseptics cover a multitude of septic sins, the surgeon who is uncontaminated by odors and germs from offensive discharges, gangrene, infectious or contagious diseases certainly has less to contend with in his efforts not to infect his patient.

The instruments required for the successful performance of an uncomplicated ovariotomy are very few and simple. As we often happen, however, upon the unexpected in the abdominal cavity, it is well to have sterilized at the same time and in the same way everything which we might require in case the operation had to be finished in quite a different manner from what was expected at the start. (For a detailed description of the sterilization of instruments readers are referred to the section in this work devoted to that subject.)

The *instruments* required are—

A sharp scalpel.

Half a dozen hæmostats.

Half a dozen prepared sponges or gauze pads.

Two pairs scissors, one long and straight, and one curved on the flat.

Dissecting-forceps, to pick up the peritoneum.

A trocar, not too pointed, with long rubber tubing attached to convey the fluid into a receptacle under the table on the floor.

Two large cyst-forceps, to grasp and withdraw the empty sac.

Two long-handled Peaslee or aneurysm needles, threaded at the point, to transfix and carry the silk into position to ligate the pedicle.

Price's or some other good irrigation apparatus, with which to wash out the pelvic and abdominal cavity when necessary.

A dozen needles, long and straight, to sew up the abdominal walls, or curved if preferred to use with a needle-holder.

Plenty of sterilized silk or silkworm gut or catgut, according to the choice of the operator.

Glass drainage-tubes and syringe, to empty the tube.

The necessary dressings are very simple:

Iodoform or aristol, to dust over the wound.

Several sterilized gauze pads; adhesive strips, an inch wide.

Bandages with safety-pins.

Three or four dozen towels.

Absorbent cotton.

Instruments in separate trays which may be needed:

More pressure-forceps large and small.

A female catheter; a male is preferable, however.

Retractors.

Rubber cord, for temporary compression.

Fine curved and straight needles, to repair wounds in intestines, bladder, or omentum.

A portable electric light, to illuminate the abdominal or pelvic cavity when needed to find bleeding points or to place ligatures or sutures.

A thermo- or galvanic cautery and Monsel's solution.

Sponges.—Sponges or gauze pads should be prepared with the greatest care according to directions given in the section on Technique. They should be carefully selected or made, and their number accurately written down, thus avoiding mistake or discussion over the number in use. The same care should be used in noting the number and variety of artery-forceps, scissors, etc. When the operator is ready to close the abdominal incision an accurate count should be again made, as these articles have been repeatedly left in the abdominal cavity, requiring the reopening of the wound for their removal or causing the death of the patient.

All instruments, sutures, drainage-tubes, etc. needed in the operation should be carefully assorted and placed in trays upon a table very near and to the right of the operator, where he can reach them himself, without their passing through the hands of an assistant.

It is well to have on a tray with the anæsthetic, within reach of the anæsthetizer in case of need, a hypodermic syringe filled with whiskey; strychnia in solution $\frac{1}{30}$ of a grain; nitrate of amyl and nitro-glycerin; atropine $\frac{1}{80}$ of a grain. A life has occasionally been saved by having powerful restoratives at hand ready for instantaneous use. Desperate operations for relief of ruptured blood-vessels or pus-sacs in the abdominal cavity are helped through by their quick and intelligent use, when without them fatal shock or collapse might have carried off the patient. A tank of oxygen and a quart of hot normal salt solution should also be within reach.

A basin of hot water should be placed upon a small table just behind the surgeon, where he can turn and wash his hands whenever they become soiled with pus or fluid from the tumor. A nurse should understand that she should change this water whenever it becomes soiled.

Everything likely to be needed during the operation being sterilized and ready for immediate use, the patient can be brought in and placed on the operating table. To save her feelings, it is better to arrange her clothing and anæsthetize her in an adjoining room. (Readers are referred to other parts of this work for directions for preparing the field of operation, the arrangement of sterilized towels and of the nurses, with their sponges, basins, hot and cold water, dressings, etc.; also for a description of the abdominal incision.)

The writer's arrangement for an ovariotomy is represented in Fig. 345.

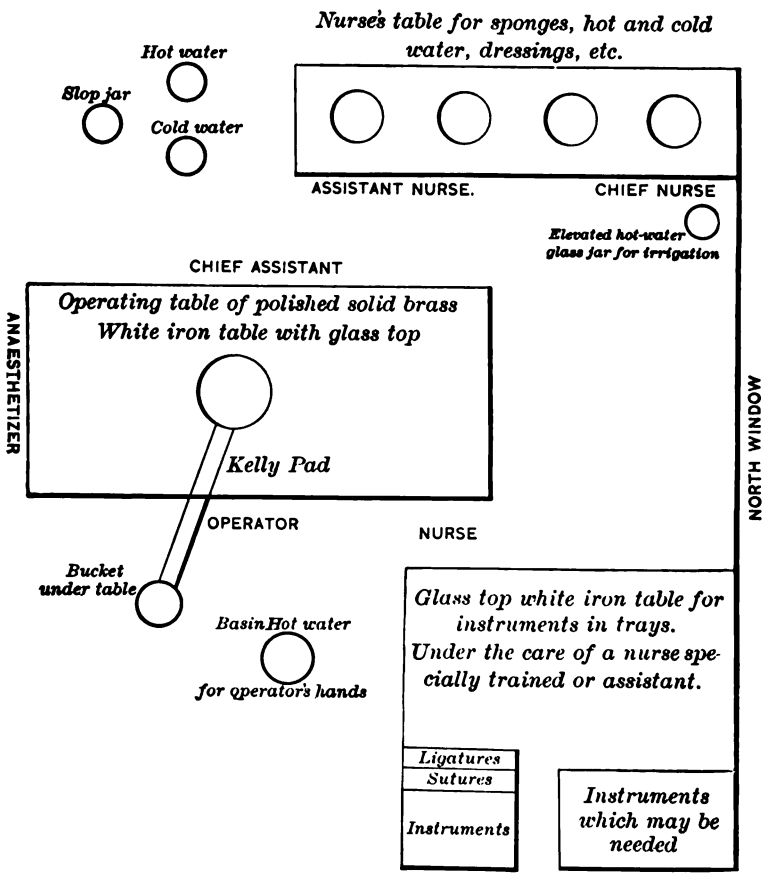
The Operation.—The operation itself may be described conveniently under the following heads:

1. Incision of the abdominal wall.
2. Tapping and removing contents of the cyst.
3. Treating adhesions of the cyst and ligating pedicle.
4. Toilet of the peritoneum.
5. Irrigation and drainage.
6. Accidents and complications.
7. Closing the wound.
8. Dressings.
9. After-treatment.

The Anæsthetic and the Anæsthetizer.—Ether is preferred, as the safer in the long run. Chloroform should be given when the kidneys are diseased. Surgeons in our Southern States generally give chloroform, while some prefer the A. C. E. mixture. Statistics, however, show fewer accidents to have happened when ether has been administered. Its administration should be entrusted for so grave an operation as ovariotomy only to an expert. The practice of allowing nurses, medical students, and inexperienced physicians to give the anæsthetic in abdominal operations is bad, and should be condemned. The success of an operator is more influenced by the skill of his anæthetizer, his chief assistant, and nurse than is generally realized. When possible, he should keep the same assistants at his operations. His comfort as well as results will be better if he does.

The *incision* need not be made longer than three inches at first, and should be carefully and deliberately made. It is not good surgery to open the abdomen with one stroke of the knife; it is rash, reckless, and dangerous. Many cysts from thirty to sixty pounds in weight have been successfully removed through incisions less than four inches in length. The incision may be elongated when necessary to deal with adhesions or to deliver tumors which are partly solid and too large to extract through a small opening without bruising the tissues. It is

FIG. 345.



always easy to enlarge the incision, and this should be done when required. It takes less time and does less injury to the parts to operate through the short incision, and requires less time, less ether, and less manipulation to close it—elements which it is well to consider in weak and exhausted patients.

When the peritoneum is reached it should be caught up and nicked between two pairs of forceps: before doing so, however, it is well to roll the tissues gently between the thumb and finger to make sure that a knuckle of intestine is not included in tissues to be cut. As soon as the

peritoneum is opened air rushes in, and the intestines, unless adherent, fall back out of harm's way. The index finger can then be inserted and the peritoneal opening enlarged with the scissors, the finger acting as a protecting guide and director. One or two fingers can now be passed in all directions to discover the nature and extent of any adhesions.

Emptying the Cyst.—The wound will now gap open and expose to view the pearly-gray cyst-wall; this may be tapped with a good-sized Wells or Tait trocar and the fluid conducted off, through rubber tubing, into a receptacle under the table. The relaxing cyst should be caught with large forceps and gradually drawn out. The assistant should press the abdominal walls against the retracting cyst, thus aiding in the expulsion of its contents, and at the same time preventing the escape of the intestines and the contents of the cyst from soiling or infecting the abdominal cavity.

If the tumor is multilocular, the trocar or, preferably, the fingers can be made to puncture one cyst after another until it is entirely empty.

The opening in the cyst-wall should be kept outside the abdomen during the manipulation. If its contents should be colloid or the fatty matter of a dermoid, it would be exceedingly difficult to wash out and cleanse the abdominal cavity of such gelatinous and sticky fluids.

Adhesions.—As the emptied sac is withdrawn its adhesions, if any exist, will come into view. If they are recent and the result of inflammation, they can readily be separated with the fingers or slowly pressed off with a sponge. If they are old or firmer, they may require cutting with the scissors between two catgut or fine silk ligatures. Omental adhesions are especially vascular and may require many ligations. The most dangerous adhesions are to the intestines. When these cannot be separated without endangering the integrity of the bowel, a piece of the cyst-wall, with its secreting inner membrane peeled off, should be left attached to the gut. Should the intestine be lacerated, it should be immediately grasped in the fingers for fear of losing it, and held by the assistant until the operator can secure his needle and fine silk and carefully sew up the rent.

Adhesions deep down in the pelvis cause much trouble, and are often vascular and difficult to deal with. Hot water and sponge-pressure generally arrest the hemorrhage. In rare cases it may be necessary to leave the pelvis packed with gauze, enclosed in a Mikulicz pouch to control the bleeding and prevent the adhesion of raw surfaces. Incomplete operations, as a rule, are more fraught with danger than the complete removal of the cyst.

The pedicle of an ovarian tumor is made up of the ovarian ligament, a portion of the broad ligament, and the Fallopian tube, which occasionally is extended up over the surface of the tumor. As the empty sac is drawn out of the wound, this pedicle or stem from which the tumor grows comes into view. Formerly, under the teaching of Sir Spencer Wells in England, and of the Atlees, Peaslee, and others in this country, the pedicle was clamped outside of the abdominal wound. Now the universal custom is to ligate it with strong slender silk or catgut ligatures and drop it back into the pelvic cavity.

The empty sac or delivered tumor, if it be partly or entirely solid, is now held up by the assistant. The operator has thus a better opportu-

nity to re-examine the attachments at the base of the tumor and to reduce the size of the pedicle to its smallest dimensions compatible with safety, by peeling off portions of the broad ligament and other hypertrophied tissues until he gets down to the real pedicle. This he transfixes with a long-handled, dull-pointed needle, threaded at the point with a loop of pure Chinese twisted silk, which, when carried into position and cut, forms two ligatures. These are to be securely tied in opposite directions, thus securing each half of the pedicle separately. If doubt exists as to the perfect constriction of the vessels, one of these ligatures can be brought around the entire mass and again securely tied. A figure-of-8 ligature is made by simply passing the ends of the silk over each other, interlocking them, and thus preventing the separating or splitting of the inner tissues of the pedicle.

Pure Chinese twisted silk is preferred to catgut or any other ligature material. When properly sterilized it should give no trouble. If the necessary caution be exercised in its introduction, it can be kept clean, and should remain for ever after free from infection. Occasionally it has become infected by filth about the wound or by the admission of germs through the drainage-tube. Minute abscesses and small fistulæ have resulted to torment the patient and surgeon for weeks or months afterward. But this is a small matter compared with the septic troubles and hemorrhages which have occurred from impure or slipping catgut. Not a few deaths have been reported from internal hemorrhage resulting from the relaxing, untying, or slipping off of catgut ligatures from the ovarian pedicle. Deaths have also been attributed to sepsis caused by improperly prepared catgut. Formaline solutions should now prevent sepsis. When the pedicle is especially broad and thick, it may require ligation in several places, making what is called the interlocked or chain ligature. The button of tissue remaining should be cone-shaped, the inner portion thus being longer than the outer edges, as in cases of tissue retracting through the grasp of the ligature it is always the inner part that slips through first.

Certain broad-ligament and parovarian cysts have no pedicle whatever. In these cases the tumor has to be enucleated out of its bed by a process specially described by Miner of this country, and any bleeding vessels showing themselves separately tied. After the ligature of the pedicle and the arrest of all hemorrhage the other ovary should be examined, and, if found diseased, it should be removed also. If it and its accompanying tube are found healthy, they should be let alone.

The Toilet of the Abdominal Cavity.—When a clean, simple ovariotomy has been performed very little remains to be done—the less the better. All unnecessary manipulation and exposure of the abdominal viscera should be carefully avoided. A small sponge, securely held by a long-handled locked forceps, should be gently passed down into the pelvic cavity, and all blood or other fluids removed: if none are present, the omentum should be carefully drawn down over the intestines and the wound closed. In cases where the omentum has been adherent to the tumor it should be drawn out of the wound, gently spread out over hot towels, and carefully examined for bleeding points. If the hemorrhage cannot be controlled by sponge-pressure or douching with hot water, ligatures should be applied back of the torn surfaces. The lace-

rated tissues should be removed and the remaining portions spread over the intestines as far as they will go. In all cases where there has been much bleeding from the separation of adhesions, and the abdominal cavity has been soiled by discharges from the torn cyst, especially if the tumor be suspected of malignancy or has contained pus, the abdominal cavity should be irrigated with distilled hot water. No chemical irritant or antiseptic solution of germicidal strength should be brought in contact with the peritoneum or abdominal viscera. Chemical solutions of sufficient strength to be of any service in destroying germs would do more harm than good. It is quite probable that many cases of adherent intestines and obstruction of the bowels have been caused by the irritating solutions used in completing the toilet of the peritoneum. Clean boiled water is all that is necessary. Possibly a normal salt solution might be employed with benefit, but this is not necessary unless used for the additional purpose of transfusion. Water, to the extent of several gallons, may be used to disengage and wash out tenacious and infectious material from colloid, dermoid, or pus-tumors.

Localized collections of infected fluid may be washed into remote portions of the cavity by unwise irrigation. If a glass drainage-tube be used, clear water may be left in, and afterward allowed to absorb or to be drawn out through the tube.

A thin gauze pad of flat sponge may be placed smoothly over the omentum immediately under the incision, and the wound closed with silkworm-gut interrupted sutures.

Some operators prefer to use three tiers of sutures in uniting the abdominal walls: one running suture of catgut or kangaroo tendon uniting the cut edges of the peritoneum; another, of the same material, through the muscles and fascia; and a third, through the skin with silkworm gut. When this is done, of course the gauze pad or sponge has to be dispensed with, as there would be no way of removing it. Where one row of sutures is passed through all the tissues, the sutures should enter the skin very near the margin of the wound, including more of the intermediate tissues, and come out near the edge of the peritoneum. The same should be done on the opposite side. In this way the edges of the separated fascia and muscles will be brought more firmly together than when the needle is passed straight down through all the parts. Four sutures to the inch should be used.

Drainage.—If no fluids of an irritating or malignant nature have been allowed to get into the peritoneal cavity, and the oozing from torn surfaces is not free, there will be no necessity for drainage, especially if the patient is young and the peritoneum healthy. In those cases, however, where many adhesions have been separated and much time is required to arrest slight bleeding, and where the contents of dermoid, suppurating, or malignant cysts have so soiled the abdominal viscera as to require irrigation, a glass drainage-tube should be used. The exhaustion of this tube by an easy-working, long-nozzled, hard-rubber syringe is preferable to gauze strips. After these strips become soaked they no longer drain by capillary attraction, and puddles of fluid may accumulate in the pelvis. This is obviated by the sucking action of the syringe. The glass tube also gives early warning of internal hemorrhage. When the fluid obtained amounts to only a drachm or two, and that light in

color and free from odor, the tube may be withdrawn. It frequently happens that the tube can be removed in a few hours. It is rarely kept in more than twenty-four or thirty-six hours. Objections urged against its use are—that it requires frequent emptying by an experienced nurse or physician; that pathogenic germs enter and infect the peritoneal cavity through it; that it is more likely than gauze to be followed by fistula and ventral hernia.

The *dressings* described in other parts of this work may be adopted. That used by the writer is very simple, and is as follows: The wound being rendered thoroughly dry, a thin piece of sterilized gauze is cut almost in two—one half laid on the abdomen, each side of and close to the wound; and the long ends of the sutures, still grasped by a catch-forceps, laid on one side of this pad, thus preventing their contact with the skin. No iodoform powder is dusted over the wound, as was formerly the custom. It is not a good antiseptic, unless carefully sterilized, and, besides, has such a bad odor as to be disgusting to the patient. It gums up the surface of the wound and makes the subsequent removal of the sutures more painful and difficult. Other pieces of gauze are now spread over and to both sides of the wound, the forceps grasping the sutures removed, and a large square pad of "combined dressing" laid over the abdomen. If the tumor has been large and a deep cavity remains from the sinking in of the abdominal walls, this may be padded out even with the iliac crests with sterilized absorbent cotton. Two strips of adhesive plaster are placed over these dressings to hold them in position. Over all this is fastened a thin flannel abdominal many-tailed bandage. Where a glass drainage-tube has been used, a piece of rubber dam about six inches square, having a perforation in its centre, is stretched over the top of the tube and spread out over the other dressings. The discharges from the tube and from the syringe used in emptying it are thus prevented from coming in contact with and soiling the dressings. A piece of sterilized gauze may be placed in the top of tube, and secured from slipping inside of it by a safety-pin. A small mass of absorbent cotton is now placed over and around the tube, and the four corners of the rubber dam are brought up over it and pinned together. A sterilized towel is placed over this and fastened at the four corners. One corner can be unpinned and lifted whenever it is necessary to empty the tube without disturbing the rest of the bandage.

After-treatment.—The directions for after-treatment in uncomplicated cases of ovariotomy consist as much in what should not be done as what should be done. When the surgeon has finished the operation, closed the abdominal wound, applied his dressings, and placed his patient comfortably in a warm bed, he has done about all he can do to save her life. Where no drainage-tube is used the dressings need not be examined for at least a week. The patient should not take medicine to allay the nausea produced by the ether or for any other purpose except to move the bowels, and that can frequently be accomplished by glycerin suppositories, enemata, or hypodermic injections of three-grain tablets of sulphate of magnesia. When these do not move the bowels by the third day, one-fourth of a grain of calomel may be administered every half hour until two grains are taken, and followed by teaspoonful doses of Rochelle salts every two hours until the bowels do move. When an

ovariotomy patient has had a good movement from the bowels, she may be considered convalescent. She should not take food or drink during the first twenty-four hours. On the morning of the second day she may begin with teaspoonful doses of hot water or table tea, and if this is well borne her drink may be gradually increased in amount. The first food taken, especially in cases where nausea continues, should consist of small sips of equal parts of milk and lime-water. As soon as the stomach can bear it animal broths and essences should be substituted for the milk, and this gradually increased in amount until she can take a cupful at a time, and this kept up every two hours while awake for four or five days, when the ordinary diet may be gradually resumed. The patient should not see visitors for at least a week after her operation, but be left largely to the ministrations of a cheerful nurse, who should keep her as quiet as possible, both mentally and physically, see to it that she is clean and comfortable, and encourage her to get well. She should be urged to pass her water in a bed-pan, thus avoiding the irritation of a catheter, when that is possible. The patient should not take opium in any shape if it can be avoided. The writer believes that the sum of a patient's pain, nervousness, restlessness, and discouragements is vastly increased by the unwise use of this drug. There are cases, however, where one has to administer a hypodermic to quiet restlessness more than the pain of nervous, frightened women who have not much power of self-control. Opium constipates the bowels, locks up the secretions, prevents the discharge of gases, favors wind colic, dries the tongue and throat, frequently produces nausea and vomiting, destroys the appetite, causes nervousness, creates a craving for more, generally discourages the patient, and renders the nursing much more difficult. In that class of sufferers who have previously become addicted to its use the drug should be gradually reduced in amount until it is withdrawn altogether. When the bowels are painfully distended by collections of gas the introduction of a rectal tube will often afford the greatest relief. If there has been no rise of pulse or temperature, the dressings should not be disturbed until the seventh day, when they should be gently removed. If the wound seems well united, the sutures may now be all taken out, the abdomen washed with a sublimate solution, and adhesive strips of rubber plaster an inch wide placed across the wound to hold it securely while a firmer union is taking place. A pad of "combined dressing" may be placed over the abdomen and held in position by a clean bandage.

When the tumor has been large and the incision longer than usual, to guard against ventral hernia it is better that the patient should remain in bed at least three weeks. Young, vigorous women, where the incision has been short and the convalescence uninterrupted by stitch-hole abscesses or suppuration of the wound, may get about at the end of the second week. Since the writer has substituted silkworm-gut for silk sutures in closing the abdominal wound he has not had any trouble from stitch-hole or mural abscesses in his abdominal work. The wound need not be dressed oftener than once a week during convalescence. The patient may be dismissed during or at the end of her fourth week, but should be admonished to wear a well-fitting abdominal supporter for the next six months, better for a year, as a prevention against the occurrence of ventral hernia.

Accidents during ovariotomy may happen from the administration of the anæsthetic, as in any other serious operation. They are less likely to occur if the patient has been previously examined thoroughly and repeatedly for a weak heart or disease of the lungs or kidneys. The time occupied in the operation and the quantity of ether inhaled, as well as the manner of its administration, have much to do in causing these accidents. A patient may have no trouble whatever from the quantity of ether consumed during an operation, lasting from thirty to forty minutes, while she might not recover from its effects when kept under its influence an hour and a half or two hours if she had a weak heart or a surgical kidney.

The peritoneum may be opened without recognizing it, and the omentum may be mistaken for the subperitoneal fat. The peritoneum has been mistaken for the cyst-wall and accidentally stripped off from the abdominal walls. It has also been pushed off by passing sponges through a too small incision. Unless it can be properly restored to its normal relations, it had better be cut away to prevent necrosis. The cyst-wall may be accidentally ruptured while separating adhesions and the abdominal cavity deluged with the contents of the tumor. Little harm generally results: it requires only sufficient irrigation to wash out the offending material, and perhaps drainage.

Hemorrhage.—If adhesions have been properly managed and the pedicle suitably ligated, there should be no fatal accidents from this cause. Bleeding points have been overlooked, however, in the omentum, about the liver, bladder, uterus, and deep down in the pelvis, which, when reaction takes place, may pour out a sufficiently large quantity of blood to destroy the life of the patient. Patients have been lost also from ligatures cutting too deeply into the tissues of a soft pedicle or from the slipping of ligatures, or the too early absorption of a poor quality of catgut. Vascular adhesions should be cut between two ligatures when possible. Our technique has been so perfected of late as to prevent the occurrence of those horrible accidents of fatal hemorrhage on the operating table which were too frequent in former years.

Extensive bleeding surfaces, arising from removal of malignant papillary or intraligamentous tumors, are now successfully treated by hot water, sponge-pressure, or gauze-packing.

Accidental Injuries to the Viscera.—Operators neglecting the details of perfected technique in opening the peritoneum have accidentally wounded the intestines, omentum, or bladder, or with the stroke of the knife, which opened the peritoneum, have cut directly into the tumor itself. Where the omentum has been cut or lacerated, if the hemorrhage is too severe to be controlled by sponge-pressure, ligatures should be applied. Torn or wounded places in the intestines should not be allowed to slip out of sight, but sutured at once; so also with injuries to the bladder. The writer once unfortunately opened the bladder, which was adherent to and spread up over the tumor. He recognized and sutured the incision immediately, and no harm resulted from this accident. The ureter has been cut or torn across, necessitating either the removal of the kidney or the opening and suturing of the distal extremity of the ureter into the bladder.

When an operator has accidentally stumbled upon the information,

after he has opened the peritoneum, that he has an inoperable tumor to deal with, he had better retreat before any further harm is done and close the wound. Incomplete operations are much less frequent than formerly. It is a question of judgment born of experience to know when to stop. It is safer for the patient, however, to proceed to a finish, even in the face of apparently insurmountable difficulties, than to stop when one is half through an operation.

Obstruction of the bowels may be caused by paralysis, kinks, or twists produced by handling or prolonged attempts at replacement. Adhesions may also take place to torn surfaces or to the raw end of the stump. These obstructions are best prevented by a careful technique, as little manipulation as possible, and by early movements of the bowels.

Early reopening of the abdomen has saved a goodly number of patients who would otherwise have died. Twists have been untwisted, kinks and volvuli straightened out, inflammatory bands and recent adhesions separated, knuckles of intestines liberated from strangulation in slits or holes in the omentum. Intestines have been obstructed also by the sutures used in closing the incision in the abdominal wall. Lives have been saved by retying ligatures which did not sufficiently constrict the bleeding vessels or which had slipped off altogether in the restlessness or vomiting during recovery from the anesthetic.

Fistulæ, following the use of infected ligatures, may persist for a long time, especially where drainage has been necessary. They generally close up after a while, but subsequent operations have been necessary in rare cases to find and remove the offending ligatures or curette away the pyogenic membrane lining the discharging sinus. When abscesses in the pelvis have formed, opening through the vagina has been successfully practised in a few cases and through-and-through drainage established.

Fecal fistulæ are best treated when small and low down by keeping them clean and letting them alone. Large ones discharging most if not all the fæces situated higher up require operation for closure or resection of the bowels.

Ventral Hernia.—Ventral hernia is an accident which ought not to occur, but which actually happens in about 10 per cent. of all abdominal sections. It entails upon the unfortunate patient sufferings hardly less severe than those which the laparotomy was performed to relieve. In some cases women have been more troubled by a ventral hernia than they were by the tumor whose removal resulted in this accident. It is said to occur more frequently in those patients who have been drained.

Prevention is attempted by many surgeons by closing the abdominal incision with three rows of sutures—one through the peritoneum, another through the muscle and aponeurosis, and a third row including only the skin. Results, however, do not show that fewer hernias occur after this long and tedious process than after through-and-through suturing when proper care is observed to securely bring together like tissues to like tissues in the manner already described.

Patients are permitted to walk about and are dismissed too soon after this serious operation, even while they should be in bed. Reports in the

journals too often state that "laparotomy patients have recovered without an untoward symptom, and were discharged on the tenth or the twelfth day."

The best way to prevent ventral hernia is to sew the tissues securely together, keep the patient quietly in bed for two weeks: where the tumor has been large and the incision long, three weeks is safer than two. Before leaving the hospital a well-fitting abdominal bandage should be applied and the patient directed to wear it for a year. She should slowly resume her usual avocations, and be especially cautioned against lifting heavy weights, straining at stool, or contracting a cough.

Battey's Operation.—On the 17th of August, 1872, Dr. Robert Battey of Rome, Ga., startled the world by describing a new operation for the removal of normal ovaries for the purpose of bringing on an artificial and premature change of life. The patient upon whom Dr. Battey performed this operation had been under his treatment for a number of years on account of pain and many incurable reflex nervous symptoms which accompanied her monthly periods.

His theory was, if the ovaries should be removed there would afterward be a cessation of ovulation, and if there was a suspension of ovulation there would be, as a consequence, a cessation of menstruation, and if the menstruation could be prevented or cut off altogether the pain and nervous symptoms the woman was suffering from would be relieved, and the patient would be henceforward cured.

It was not his purpose to remove these organs on account of any supposed disease, but to bring on an artificial change of life.

The operation fortunately succeeded and the patient was relieved from her troubles.

The field of this operation rapidly widened until too many operators were removing ovaries for the purpose of allaying pain and checking a large variety of nervous symptoms which seemed to cluster around and to culminate at the monthly period, until quite an outcry arose in the profession against this too wholesale mutilation of women, as it was called.

The pendulum has now swung so far in the other direction that at the present time Battey's operation for the relief of reflex nervous symptoms and pelvic pain is rarely performed.

It was gradually found on investigation that all the patients who had been operated upon for the relief of such symptoms were not cured: some were only relieved for a short space of time, as they might perhaps have been by any other radical measures which might have produced a marked and sudden effect upon their nervous systems. Occasionally these patients come back to the operator, or more likely go to some other doctor, with their aches and pains as bad as ever.

The removal of the ovaries and tubes for the arrest of hemorrhage and the checking of the growth of fibroid tumors stands on a much more firm foundation. Experience has shown that the expectations of operators in this class of cases have been generally realized. It is very successful primarily, and the effect has been such as to greatly encourage those who are operating in this direction.

After fibroid tumors have attained considerable size and have acquired other vascular supply through adhesions, it would be unwise and

useless to do Battey's operation, as the blood-supply which we cut off by tying the ovarian arteries would not deprive the tumor of its nourishment sufficiently to check its growth or prevent hemorrhage. When these tumors are no larger than a cocoanut or a child's head, this operation has proven itself in numerous instances to be one of the most successful means of dealing with this very troublesome and anxious class of cases. The immediate mortality of the operation should not be above 3 per cent. The writer has performed this operation in 36 instances on account of bleeding fibroid tumors, and, so far as heard from up to date, has had the most gratifying result in arresting the hemorrhage and checking the growth of the tumor. *There was no death in this series of 36 cases.*

Speaking of the results of this operation, it is necessary to state that there are a certain number of failures to cure, and that they occur in about the same proportion of cases in which the change of life fails to check the growth and hemorrhage of fibroid tumors.

Recent investigations have shown the effect of the menopause to be much less than was formerly taught. In presenting the claims of this operation to patients this possibility of failure should be mentioned. It might aid in a final decision between oöphorectomy and hysterectomy. Battey accounts for the continuation of menstruation after his operation in about 5 per cent. of the cases on the theory that there may be a third ovary.

Dr. Arthur Johnstone of Cincinnati, in common with most surgeons, accounts for the continuation of menstruation by the failure of the operator to remove all the ovarian stroma and the entire Fallopian tube, believing that in cases where the periods continue enough of the ovaries and tubes had been left to keep alive the menstrual habit. Johnstone lays special stress, however, upon the presence of a ganglion of nerves near the point of departure of the tube from the uterus, which is to a large extent, he states, the cause of menstruation. Failure to remove or tie off this ganglion permits the continuation of the monthly flow, even if the ovary and the greater part of the tube have been removed.

The liability of a long tubal stump to permit fluid collections of pus, mucus, or blood emphasizes the necessity for the more complete removal than was formerly believed necessary.

Recently the operation has been performed with considerable success in cases of menstrual insanity. The writer has had two remarkable patients, one of whom was taken from an insane asylum, the superintendent of which stated that "she was incurable by any methods under his control, and was a proper subject for Battey's operation." In both these cases the operation was done for the purpose of removing normal ovaries. They were found, however, to be greatly diseased, although the extent of the disease had not been previously recognized. The operation was done only for the purpose of bringing on a premature and artificial change of life, in the hope that this enforced cessation of the menstrual flow would do away also with its attendant nervous and insane phenomena.

In one of these patients the transformation from a drivelling, disgusting lunatic, hopelessly confined behind the locked doors of an insane asylum, to a charming and beautiful lady is little less than marvellous.

The gratitude of the patient and her family is simply boundless. She is now happily married.

In the second case referred to, and in quite a number of others within the personal experience of the writer, it is believed that patients were not only saved from the insane asylum, but from self-destruction. Goodell, Price, and other gynecological surgeons have reported similar cases.

Increased experience has shown that many of the dysmenorrhœal and nervous patients can be cured by appropriate treatment very much oftener than we formerly supposed. The sentimental cry about unsexing and mutilating should have little influence upon the surgeon, inasmuch as the unsexing is done already by the disease which we operate to cure, making it impossible that the desire for offspring should ever be realized. If oöphorectomy were only done for the premature production of the menopause—upon Battey's theory, in the practice of which he and others removed normal ovaries—this objection might apply, but in this day of improved practice a surgeon who presents normal ovaries to a medical society has to show very good cause for his operation to escape censure.

If ovulation and conception are unobstructed by disease, the operation should not be done. If the ovaries are sufficiently diseased to require removal to save life or reason, conception and childbirth are thereby rendered impossible. The woman is unsexed or sterilized by the disease, and the surgeon who wards off death or insanity by his timely operation does good work.

Still another objection is brought against Battey's operation, on the ground that the nature of the female would be so entirely changed by the removal of her ovaries that all sexual desire would be abolished. Examination of a sufficiently large number of cases has been made to show that this result is an exception and not the rule. These women are improved, by this operation, in their personal appearance, and unchanged, as a rule, in their sexual nature. Goodell says: "They are just as womanly and just as womanish after this operation as they were before." In six cases operated on by the writer the woman married later on, and three of their husbands stated to him that their lives were blissfully happy. In another case the wife was completely changed after the removal of her diseased ovaries. Formerly she loathed and finally refused all sexual intercourse, largely on account of the pain it produced and the fear also of having children. After the operation, having neither pain nor fear, she became aggressive in her demands for sexual gratification.

In a very few cases husbands have complained that their wives have gradually grown colder, until finally all sexual desire and pleasure was lost.

As the technique in abdominal surgery approaches nearer to perfection supravaginal and panhysterectomy are likely to supersede oöphorectomy for relief from fibroid tumors, and also for other incurable diseases of the uterus or endometrium.

The removal of the ovaries and tubes, as shown above, sometimes fails to entirely cure when associated with a fibroid or otherwise diseased uterus. The uterus is certainly of no use after its appendages are gone,

and the conviction is rapidly growing among operators that in cases where oöphorectomy is indicated hysterectomy is the more radical and preferable operation to perform.

If dysmenorrhœa and endometritis are curable by dilatation, curetting, irrigation, and drainage, if the nervous and painful ailments are also cured by mechanical supports and improved operative aseptic technique, and if hysterectomy gradually takes the place of oöphorectomy, the heretofore broad field for Battey's operation will shrink down to a narrow lane. There will still remain, however, certain bad cases of otherwise incurable menstrual ailments, menstrual epilepsy, and menstrual insanity where Battey's operation may be the only cure.

The menstrual molimen may be accompanied by such a stormy train of symptoms as to make a mental and physical wreck of the sufferer. After exhausting other methods of relief, including the element of time, Battey's operation may completely remove the cause of the trouble. It is also indicated in those rare cases of congenital malformation where active ovaries exist and there is either an infantile uterus or none at all.

The results of Battey's operation should be very good, so far as its mortality is concerned. Indeed, there should be no mortality whatever in removing non-adherent appendages free from abscesses.

The writer has been in the habit, however, of stating to patients and their friends that the average failures to cure from the work of all operators amounted to about 10 per cent.; that is, that 3 to 5 per cent. died and 5 to 7 per cent. either continued to menstruate or were otherwise uncured or made worse by the operation. They may suffer more afterward by the formation of painful adhesions or from a ventral hernia than they did before.

In the hands of the most expert operators these failures and bad results have greatly lessened in frequency, and should not occur at all.

With some unruly patients and in some unclean environments perfect results are unattainable by the best operators. (For a description of the technique of this operation readers are referred to the preceding paragraphs on Ovariotomy.)

Some points of difference, however, may be referred to, such, for instance, as the length of the incision, the time consumed, the unnecessary handling and exposure of the viscera, amount of ether absorbed, and less liability to hernia.

In doing Battey's operation the incision in the abdominal wall need not exceed two and a half inches. An opening large enough to admit two fingers without bruising the parts is all that is required. General surgeons often err in this particular by bringing their long incisions and rough manipulative methods into this special field of work. The writer has witnessed operations where a wound of five to six inches was made, one whole hand put in, and then the other, and the intestines let out—all unnecessarily. Time is an important element in all abdominal operations. The longer the incision the longer it takes to make it and to close it.

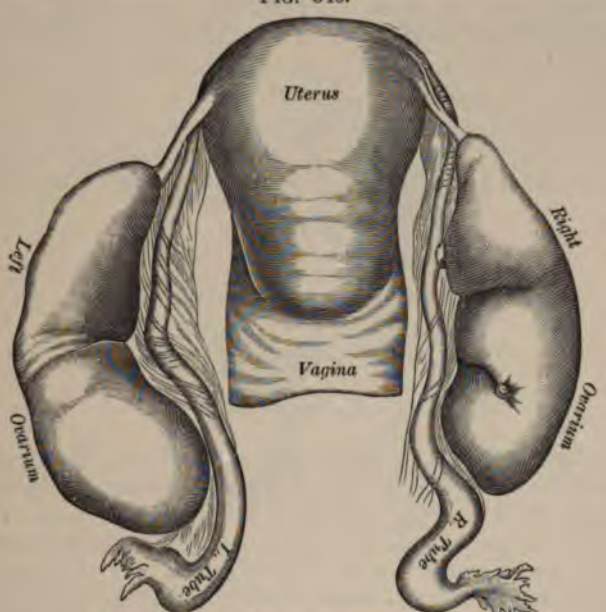
The risk of intestinal protrusion is increased with the long incision, and many unnecessary elements of danger are added to the operation, such as the kinking of intestines from hasty attempts at replacing after protrusion. All handling and exposure to the air of the intestines, even

though they may be covered with hot towels, increases the tendency to shock and subsequent adhesions and obstruction of the bowels. This should and can be avoided. This risk is greatly lessened by the short incision. It is idle talk to claim that subsequent hernia is no more liable to occur after a six-inch incision than when it is only two inches long.

Surgical Diseases of the Fallopian Tubes.

The Fallopian tubes pass out from each cornua of the uterus, are about four inches long, and are lined by a mucous membrane similar in character to that lining the cavity of the corpus uteri. The tubal lining membrane is thrown into numerous plicæ or folds and is covered with ciliated epithelium. The cilia have a wave-like motion extending from the abdominal end of the tube toward the uterus, and are supposed to assist in passing the ovum from the ovary to the uterus. These tubes are narrow as they leave the uterine wall, widen out gradually, and ter-

Fig. 346.



Unusual length of tubes with enlarged ovaries.

minate in a fimbriated extremity. One of these fimbriæ attaches the abdominal ostium to the ovary. The especial office of the tube is to carry the ovarian secretion to the uterine cavity. On account of the similar character of the uterine and tubal lining membranes diseases of the endometrium are easily transmitted by continuity to the tubal mucous membrane, and, still further, on account of the close attachment of the tube to the ovary, disease of one is easily transmitted to the other. The peculiar arrangement of the tubal lining membrane is such, when diseased, as to favor the occurrence of extra-uterine pregnancy.

The surgical diseases of the tubes are—salpingitis, hydrosalpinx, pyosalpinx, hæmatosalpinx, and tubal pregnancy. Malignancy and tuberculosis may also require surgical interference.

SALPINGITIS consists in an inflammation of the Fallopian tube. While the whole tube may be inflamed, the actual disease is mostly confined to its mucous membrane and should be called endosalpingitis. Catarrhal endosalpingitis is the form most frequently met with, and presents itself in both the acute and chronic varieties.

Causes.—Acute catarrhal endosalpingitis is caused by puerperal and gonorrhœal endometritis or may result from a simple endometritis produced by taking cold at the menstrual period. This inflammation extends from the cavity of the uterus to the lining membrane of the tube. An endometritis thus easily causes a salpingitis. This extension of the inflammatory process may involve the ovary: an ovaritis may result in abscess; adhesions or rupture may occur and set up a pelvic peritonitis which may finally cause a general peritonitis.

The most frequent cause of salpingitis is puerperal endometritis, while the most destructive form is that produced by the gonorrhœa poison. While there are more puerperal than gonorrhœal cases, the proportion of septic cases resulting from natural labor or abortion is smaller

FIG. 347.

Salpingitic closure of the ostium (Bland Sutton).

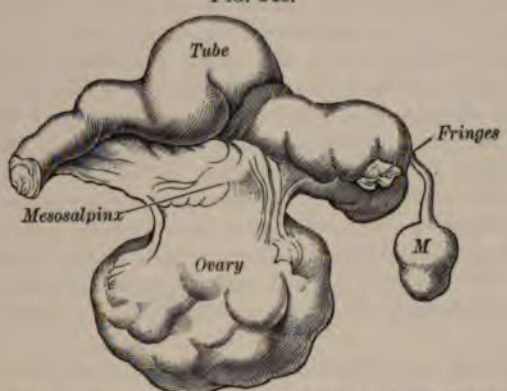
than from gonorrhœa. The class of women suffering from gonorrhœa is one in which the vital forces are less able to resist the inroads of the poison than in the better-fed and cared-for puerperal cases. The moral as well as the physical condition of specific cases is at a lower ebb than that of their more favored sisters. Their power of resistance being less, the inroads of the disease are more rapidly destructive.

The third cause often operates in young women who have exposed themselves to cold while menstruating. Salpingitis is sometimes noticed as a result of excessive venereal excitement in newly-married people, and is often noticed in prostitutes. A great number of this class become physical wrecks from the results of salpingitis and its complications. Large abscesses may not form and fatal peritonitis may not occur, yet pelvic inflammation is often produced, matting together the pelvic viscera in such a way as to keep the poor victim in a state of constant invalidism which is little preferable to death itself.

Chronic salpingitis may either follow an acute attack or may occur as a gradual extension from endometritis. One of the most constant and

injurious effects of this inflammation is to close one or both ends of the tube: all secretions then forming as a result of the inflamed mucous membrane, having no outlet, will collect and distend the tube even to

FIG. 348.



Salpingitic closure of the ostium: *M*, a pedunculated cyst (Bland Sutton).

its utmost capacity. Should the abdominal end only be closed, the collecting fluid may for a time be discharged through the uterus, and the formation of a cystic tumor thereby prevented. Little harm is done when these tubal collections are thus discharged. Should, however, any fluid containing pus, or other irritating or poisonous matters find an out-

FIG. 349.

Salpingitic closure of the ostium (Bland Sutton).

let through the abdominal end of the tube into the pelvic cavity, a local peritonitis would result which might involve all the pelvic organs or become general.

The great danger in both the acute and chronic forms of salpingitis is the occurrence of this accident: a leaky pus-tube may only produce attacks of localized peritonitis, but constant repetition of these attacks causes the most extensive and incurable forms of adhesive inflammation. The tube may be constricted at several points, thus preventing tapping through the vagina from emptying more than one cyst at a time. Where these separated fluid collections exist the appearance of the tube has been compared with that of links of a sausage. Where the fluid is all contained in one cavity the enlarged tube is said to resemble a large banana

or sweet potato. Occasionally it produces a large round tumor the size of a child's head, reaching from the symphysis pubis to the umbilicus. Where these pus-collections are the result of recurrent attacks of pelvic peritonitis, universal adhesions occur, binding pelvic organs, intestines, and omentum together so firmly as to require one of the most formidable and dangerous of surgical operations for their relief.

Frequency.—Salpingitis in its acute or chronic form is one of the most frequent of the female pelvic diseases. Although our recognition of this fact has been only of recent date, it must have been as true formerly as it is now, that pelvic diseases were the result of a puerperal or gonorrhœal endometritis and salpingitis. It is quite evident to practical men, who have verified their diagnosis after opening the abdomen, that cases formerly classified as cellulitis, parametritis, perimetritis, uterine phlegmon, and pelvic abscess had their origin in a septic salpingitis.

The merit of having liberated the profession from the thraldom of antiquity belongs first to Bernutz and Goupil; secondly and clinically, to Lawson Tait.

The **symptoms** of acute salpingitis are very similar to those of pelvic peritonitis—namely, chill, severe pain in one or both sides of the pelvis, and certain constitutional disturbances; but the temperature and pulse may not rise very high. The most frequent symptoms of the chronic form of catarrhal salpingitis are painful menstruation, defecation, and coition. Upon examination in either form slight enlargement and considerable tenderness of the tube are evident. The very common menstrual colic complained of by prostitutes is frequently caused by chronic salpingitis, and the temporary form of pelvic tenderness, bordering on inflammation, complained of by newly-married women is often produced by excessive sexual indulgence, generally during the honeymoon. This is aided and produced in many cases by the fatigues and exposures of travel during the nervous and more or less exhausted state dependent on and subsequent to the long preparation made for the bridal ceremonies. A more or less constant leucorrhœal discharge is present, which may come at times in large quantities suddenly, owing to its collection either in the tube or the uterus.

Diagnosis.—The history of the case, together with the group of symptoms mentioned above, with the information gained by a bimanual examination, ought, in a majority of instances, to settle the question. Where collections of fluid have formed within the tube a differential diagnosis is much more difficult and frequently impossible. If the enlarged and sensitive tube can be made out by the point of the examining finger, the diagnosis is reasonably certain. In some cases of chronic invalidism, however, an accurate diagnosis can only be determined by exploratory incision.

Treatment.—The early treatment of all pelvic inflammations is about the same. If an error in the differential diagnosis is made, erroneous treatment may not follow as a consequence; so that, whether the case be one of inflammation of the tube, the ovary, or the pelvic peritoneum, rest in bed, hot external applications, hot vaginal douches, purgation, and a bland nourishing diet would be appropriate. If the pain should be continuous and severe notwithstanding this treatment, opiates may be given to an extent necessary to quiet pain and produce sleep. This drug

should be avoided, however, in all chronic cases, for fear of producing the opium habit. Should the case become chronic, the patient should be directed to avoid exposure to wet and cold during the menstrual period, and also any over-exertion or excitement. The vaginal vault should be painted over daily, or at least three times a week, with Churchill's tincture of iodine, and vaginal tampons of cotton wool soaked in glycerin inserted. Any exercise which produces pain, such as horseback riding, bicycling, or dancing, the use of the sewing-machine, and going up and down stairs, should be prohibited. Sexual intercourse should be abandoned, and more than usual attention paid to the preservation of the general health. Counter-irritation by blisters and electricity should be given a fair trial. If the patient suffers from severe recurrent attacks of salpingitis and pelvic peritonitis notwithstanding the observance of the above regulations, her *final* cure, and perhaps the preservation of her life, may require the removal of the diseased organs.

HYDROSALPINX is a collection of water in the Fallopian tube. Its causes cannot be definitely stated.

The **symptoms** of this condition are not very marked, and a **diagnosis** is not generally made until after a physical examination. An endometritis followed by pelvic pain would naturally lead to a digital examination, when a tense, round fluctuating mass is discovered upon one or both sides of the uterus. This condition, together with the history of the case, makes out a tolerably clear diagnosis.

Hydrosalpinx makes itself apparent by less painful local or constitutional symptoms than either pyosalpinx or hæmatosalpinx. Pain from pressure is the principal local evidence of disease. It is in this class of fluid tubal collections that discharges take place through the uterus, or even into the peritoneal cavity, with a curative result. While the collection of fluid is dissipated, the tube may remain useless for ever afterward, the cavity having been in not a few cases obliterated by adhesive inflammation or obstructed by impassable strictures. The fluid being of a bland and unirritating character, peritonitis does not result, as it would from a ruptured pyosalpinx or hæmatosalpinx. In these cases the refilling and re-emptying of the sac is not infrequent. On account of the continued pressure of a distended tube, adhesions may take place to the surrounding tissues, which may produce a class of symptoms which may only be relieved by its removal. Where a differential diagnosis can be positively made, the withdrawal of the fluid with an aspirator would be very successful treatment. It is so difficult, however, to be certain which one of these three fluid collections we have to deal with in any given case that laparotomy is generally performed for the cure. Upon inspection the ovary may be found healthy, and certain "conservative" surgeons recommend that the tube be aspirated, irrigated, and left to the kindly offices of the *vis medicatrix naturæ*. In mild cases of non-infective salpingitis this course of treatment has been successful.

HÆMATOSALPINX consists in the distention of the Fallopian tube with blood. This collection may be caused by regurgitation of the menstrual blood from the uterus into a tube whose abdominal ostium is closed or by a retention of its own secretions. No distention could take place if both ends of the tube were normally open. As a result of a former salpingitis the abdominal end of the tube may be so closed as to

prevent any escape of fluid into the abdominal cavity. Ovulation may still take place and menstruation occur. The collection of fluid may remain in the Fallopian tube, and, as a result of ruptured vessels or of the accumulation of this and of additional fluid month after month, will form a large cyst-like collection which may amount to eight or ten ounces or even a pint. Hæmatosalpinx is formed also, and perhaps most frequently, as a result of tubal pregnancy. It is now believed that most cases of hæmatosalpinx and pelvic hæmatocele are produced by this cause.

FIG. 350.

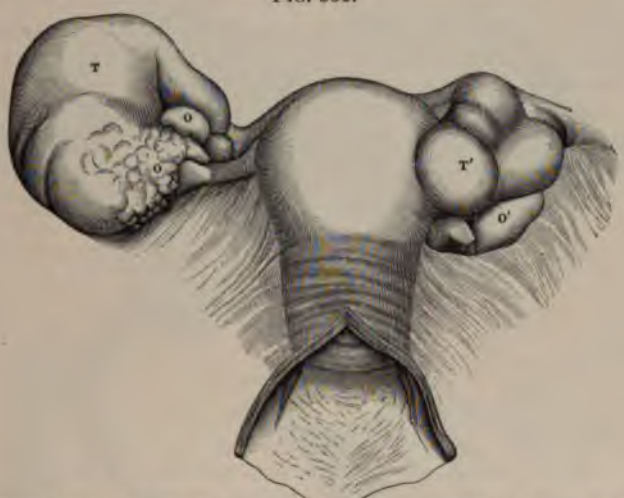
Large hæmatosalpinx, diagrammatic sketch (Mundé).

Pelvic hæmatoma and hæmatocele are also produced in many instances by rupture of the gravid tube and escape of its contents. The pain and general symptoms are the result of distention of the tube, and are generally confined entirely to the affected side. The symptoms of pressure as well as the accompanying nervous phenomena are most intense at the menstrual periods. In cases where the collection of blood has taken place rapidly the pain will be much in proportion to the rapidity of the distention. The amount of blood escaping into the tube is never sufficient to cause prostration or the anæmic symptoms which are often present in pyosalpinx and its complications. Upon physical examination very much the same condition is found as in hydrosalpinx, except that the cystic collection, having been more sudden, is not, as a rule, associated with pelvic inflammation or adhesions. The oval fluctuating mass is generally more movable and less bound down by adhesions than either of the other fluid collections which take place in the tube. On account of the more frequent sudden occurrence of the hæmatosalpinx, it is likely to be found lower in the pelvis, and consequently more easily palpated by the examining finger. A differential diagnosis is rarely possible, and is frequently only determined by an exploratory laparotomy. If it were possible to settle this point so as to decide positively which of these tubal collections could be safely ruptured or aspirated, many laparotomies could be prevented.

Most cases of hydrosalpinx and many cases of hæmatosalpinx could be safely operated on by the vaginal method if we were sure of our diagnosis: that being so uncertain, it has turned out, in some cases, which might have been safely operated on by aspiration or by tapping, irrigation, and drainage from below, that they have been subjected unneces-

sarily to the dangers of abdominal section. In many cases, especially where the hæmatosalpinx has resulted from tubal pregnancy, an operation by the vaginal route has been deemed heretofore unsafe and incomplete. The practice has thus been almost universally to open the abdomen in these cases, in order to more efficiently and completely remove foreign

FIG. 351.



Double hydrosalpinx: *t*, left hydrosalpinx; *o*, left ovary degenerated into a cyst; *t'*, right tube with abdominal mouth closed; *o'*, right ovary. Two-thirds natural size (Thomas and Mundé).

bodies and masses from the abdominal cavity and to more safely arrest hemorrhage.

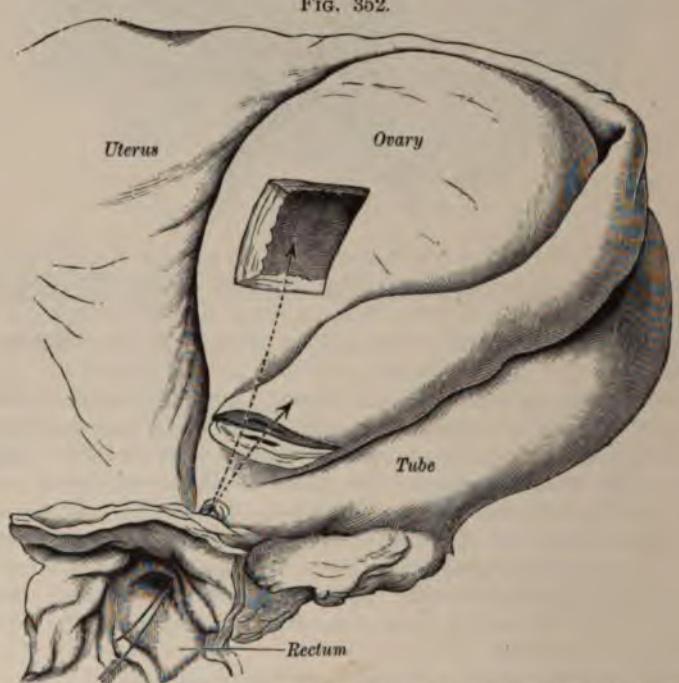
The tube may distend, form adhesions, and finally rupture between the folds of the broad ligament, without permitting the fluid to enter and soil the peritoneal cavity. In these cases, could a positive diagnosis be made, undoubtedly the best and safest treatment would be to evacuate the fluid and wash out and disinfect the cavity through the vagina. These intraligamentous ruptures of hæmatosalpinx are most frequently produced by tubal pregnancy, and are the cause of the sudden sensations of bursting, distending, tearing pain, faintness, and syncope which are often the first symptoms of ruptured tubal pregnancy for which physicians are suddenly called in.

Sterility is frequently produced by salpingitis, especially when associated with these fluid collections. Tubal pregnancy is most frequent in its occurrence after a period of sterility when some of the more prominent symptoms and complications of salpingitis have passed by. The question is frequently asked, Why are some women who have borne one child for ever after sterile? The correct answer probably is, that a puerperal salpingitis has so closed or crippled the Fallopian tubes as to shut off all connection between the ovaries and the uterus: this is probably one cause of sterility in that large class of women who follow prostitution as an occupation, but generally there is another cause. Frequently these women have given birth to one child before entering fully upon their lives of infamy. In their cases, when puerperal salpingitis

has not resulted in the closure of one or both ends of the tube, gonorrhœal salpingitis has so destroyed the functions of the tube as to make conception and subsequent pregnancy wellnigh impossible. The many post-mortems which have been made of prostitutes show that this statement is undoubtedly correct.

Pyosalpinx consists of a collection of pus in a Fallopian tube. This condition occurs subsequent to, and as a result of, gonorrhœal or puerperal endometritis, or possibly from a degenerated hæmatosalpinx. As salpingitis increases in extent or intensity the abdominal end of the tube becomes closed by adhesive inflammation, and after a time the uterine end also, making it impossible for any further collection of fluid to escape either into the uterus or abdominal cavity. This collection may cause the tube to increase in size from that of a lead pencil up to that of a banana, or it may be pear-shaped. It may occupy the abdominal end

FIG. 352.



Large pyosalpinx: the tube communicates with an abscess in the ovary (tubo-ovarian abscess), and each communicates with the rectum (Bland Sutton).

of the tube, and by pressure absorb or crumple up the mesosalpinx, thus bringing the tubal pus-sac in direct contact with an already inflamed ovary, resulting finally in a tubo-ovarian abscess. The location of a pyosalpinx is near the side of the uterus and the bottom of Douglas's cul-de-sac, permitting adhesions to take place both to the uterus and the tissues underneath. The contents of the sac is at first a clear non-odorous pus, but subsquently, from its proximity to the bowel and the possible transmission of intestinal gases, it is found most offensive, especially so in late operations. Pyosalpinx is frequently associated with fibroid

tumors and cancer of the uterus. When of tubercular origin it is referred to by some writers as a cold abscess. The walls of a pyosalpinx are generally thicker than those of other fluid collections in the tube, which probably accounts for their less-frequent rupture. Inflammatory exuda-

FIG. 353.

Pyosalpinx, with oöphoritis and universal adhesions masking the ovary (Mundé).

tions not only add to the thickness of the sac-wall, but throw around and over these abscesses organized lymph, which amounts to a second wall or partition between the pus and the peritoneal cavity. Pus may be retained in these thick-walled sacs for many months, and in some cases for years, without giving rise to septic poisoning. It is only when pus is in contact with an absorbing surface or escapes into the peritoneal cavity that general inflammatory or septic symptoms are produced.

The **symptoms** and **physical signs** of pyosalpinx are very similar to those present in hydrosalpinx, hæmatosalpinx, and chronic salpingitis. We have the same pains in the same location, the same menstrual dis-

FIG. 354.

Pyosalpinx with adhesions, ovary still distinguishable (Mundé).

orders, the same nervous symptoms, making a differential diagnosis exceedingly difficult until pus in some way makes itself manifest. The symptoms of these fluid collections are of two varieties—those resulting in local pains, and those resulting in a fluctuating tumor. Manipulation should be gentle for fear of bursting the sac. In cases where pus is

present the globular mass will yield less fluctuation, but more pain, than the other varieties.

Diagnosis.—While the diagnosis is difficult, pus should be suspected in cases having a gonorrhœal or puerperal history or where the mass is closely adherent to the side of the uterus and to the pelvic tissues. Pyosalpinx and hydrosalpinx are usually double, while hæmatosalpinx is, as a rule, single, especially when caused by tubal pregnancy. These tubal collections may be mistaken for small cysts, uterine fibroids, or displacements of the uterus. Fluctuation in pyosalpinx with adhesions is frequently not noticed at all.

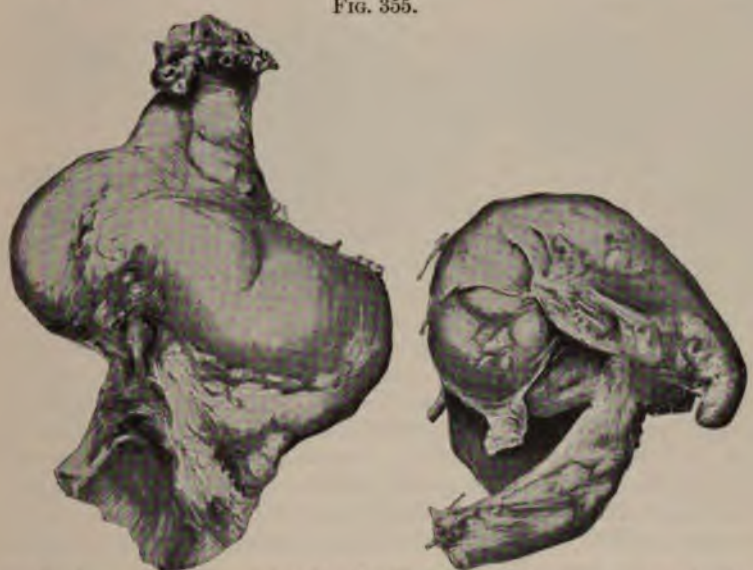
The **course** and **duration** of these tubal cysts are, as a rule, from bad to worse. They are practically incurable except by total extirpation. In cases where rupture has occurred from some accidental cause, and the patient has finally survived after a hard and prolonged struggle for existence, she is left either a chronic invalid or sterile. Patients having these tubal cysts suffer frequent relapses from over-exertion or excitement, and are unable to perform satisfactorily the duties of wife, mother, or citizen. These cases were formerly treated as pelvic inflammations, which they are now very well known to produce. In other words, a purulent or septic salpingitis is the cause of the great majority of inflammations and their effects and complications in the female pelvis. As a pus-collection distends the tube adhesions to surrounding tissues may occur; ulceration and perforation may take place, with discharge of contents through a fistulous opening into the bladder, vagina, rectum, intestines, pelvic cellular tissue, or through the abdominal wall. Partial cures are thus sometimes obtained, but relapses occur, fistulous openings keep on discharging, adhesions give never-ending pains, and the tubes are likely to remain strictured or impervious. While the woman may congratulate herself upon remaining the happy possessor of her tubes, they may be absolutely useless so far as their function is concerned, and be the cause of relapsing pelvic inflammation.

Treatment.—Drugs are of little avail in the treatment of these conditions; the only real cure is total extirpation. In some cases of hydro- and hæmatosalpinx it has been thought good treatment to dilate and curette the uterus, paying special attention to the cornua, with the hope of thus causing the evacuation of the tubal contents. These hopes frequently prove delusive. In fact, as much harm as good has been accomplished in these manipulations, causing tubal cysts to burst into the pelvis instead of turning the current in the desired direction.

Pozzi says that "as soon as the diagnosis of a cyst of the tube is established we must at once remove the diseased parts, choosing the best moment for the operation." It is better not to operate during an acute attack of pelvic inflammation, but it may be a necessity in some cases to prevent impending rupture or to save a life threatened from the effects of the already discharged contents of a ruptured pus-tube. The operation itself is frequently much more difficult and attended with more risk to life than that for the removal of catarrhal salpingitis or a simple ovarian tumor. There is scarcely any abdominal operation demanding more skill and surrounded by more difficulties and dangers than the enucleation and removal of universally adherent pus-tubes. Intestines may be torn, the ureter cut or ruptured, the bladder or rectum lacerated,

large vessels ruptured, or serious and dangerous hemorrhage produced from the large raw surface from which the masses are separated. At some weak point during the separation of adhesions the pus-sac is frequently ruptured, and foul-smelling pus pours into and infects the peri-

FIG. 355.



Abscess of both ovaries with pyosalpinx (Mondé). The sacs of the abscesses are open, having been torn during their detachment from the adhesions; the dilated tubes are above.

toneal cavity and its sensitive contents, requiring most liberal use of irrigation and subsequent drainage. In cases of pelvic inflammation from adherent and distended tubes we frequently find the omentum adherent to the top of the uterus and sides of the pelvis. This has to be carefully separated and properly treated to prevent hemorrhage before the operation proper is begun. In performing this operation one should proceed as in ovariotomy. After the omentum has been gotten out of the way two fingers of the left hand should be passed through the incision down over the top of the uterus and follow out the tube or the ovarian ligament to the diseased parts. A point of cleavage should be found and the enucleation begun, especial care being taken not to rupture the sac. It is important to enucleate these structures down to the body of the uterus, leaving as little of the tube as is possible. Many failures to cure have been caused by a failure to remove the entire tube. Where an inch of tube is left subsequent distentions may occur and the patient be still left to suffer. During the enucleation, if it becomes evident that there is danger of bursting the cyst, it may be aspirated, taking care to close the opening in the sac by pressure-forceps. Where adhesions give much trouble, making the arrest of the hemorrhage difficult, the elevation of the hips in the Trendelenburg position aids very materially. The oozing produced by enucleation is generally arrested by hot-water irrigation, sponge-pressure, or gauze-packing. Long-handled pressure-forceps may occasionally be required to compress bleeding tis-

sues deep down in the pelvis, where ligation is either difficult or impossible. If pus escapes into the abdominal or pelvic cavities during the operation, irrigation and drainage may be required. The glass drainage-tube is preferred to strips of gauze for pelvic drainage. If both tubes are diseased, they should both come out if the object of the operator is to cure the patient.

It has been recently suggested by certain "conservative" operators to remove a portion of the diseased tube and reconnect it with the ovary. In other cases it is recommended by the "conservatives" to puncture, wash out, and disinfect cysts or cavities in the ovaries or tubes and attempt to save them for future usefulness.

Of these "conservative operations" by Martin and his followers in Germany, and Polk and his followers in America, there have been so few cases of subsequent pregnancy reported that as a surgical procedure to secure that most laudable result it can hardly be referred to as anything less than a failure. It is quite probable, indeed, that more harm than good has resulted from this wave of so-called "conservatism." Inasmuch as it is believed that the "conservatives" have operated on many cases of chronic salpingitis where pregnancy was not impossible, and which many so-called "radical operators" would have cured without the knife, it is also quite probable that these "conservative" operations upon ovaries and tubes have resulted in renewed inflammations which have utterly and for ever obstructed and obliterated tubes and cavities which were left pervious after their operations.

In cases of the removal of double pus-tubes and fibroid tumors of the uterus these same "*conservative*" operators are now recommending the very "*radical*" procedure of the total extirpation of the uterus at one and the same time. In cases of septic or specific endometritis the patient would not be cured of all her troubles by salpingo-oöphorectomy. The endometritis would still be left to torment the patient. If this could not be cured by thorough curetting, it would certainly be better surgery to perform a total extirpation than to leave the patient half cured and still be the unhappy possessor of a totally useless and diseased organ. When we have such a perfected technique as to permit *this* truly "conservative," though "radical," procedure to be done without adding materially to the risk of life, it is predicted that it will become the operation of the future.

TUBAL PREGNANCY.—When conception takes place outside of the uterine cavity and the fœtus develops at the point of arrest, it is called ectopic pregnancy. Conception may take place at any point between the uterine cavity and the ovary. The ovum after leaving the ovary may be fecundated at the fimbriated extremity of the tube, at any point in its length, or in that portion lying in the uterine substance. The great majority of all these cases are tubal. Tait thinks they all are at first. He and most others who have investigated the subject believe that all extra-uterine conceptions, whether found at the time of rupture to be in the broad ligament, pelvic or abdominal cavities, were tubal in origin.

Frequency.—Recent investigations by abdominal surgeons and pathologists have demonstrated the fact that many of the hæmatoceles and sudden deaths from internal hemorrhage were caused by ruptured tubal pregnancies. Thus Formad, when coroner's physician in Phila-

delphia, reported among the autopsies made in a single year 27 cases of sudden death produced by hemorrhage from a ruptured tubal gestation-sac. From the number of cases constantly reported in the medical jour-

FIG. 356.

Tubal pregnancy (Thomas and Mundé).

nals and in the medical societies the truth is forced upon us that this condition is very much more frequent than was formerly believed to be the case.

The fœtus may develop in any portion of the tube or in the cornua of the uterus. When the development occurs in that portion of the tube between the uterine cavity and its outer walls, it is referred to as interstitial pregnancy.

The causes of ectopic pregnancy have usually been described as unknown, but it is altogether probable that salpingitis has very much to do with the causation. It is believed and taught that the ciliary movements and peristalsis of the tube have something to do in aiding the passage of the ovum toward the uterine cavity. It is also taught that these movements are greatly interfered with or entirely destroyed by septic or specific salpingitis. From the effects of these diseases strictures are produced by inflammatory bands; the occurrence of fungus, endosalpingitis, and polypi is also favored by the same cause and may produce the same result.

Tubal pregnancy occurs most frequently after several years of sterility, which has been caused in most instances by a previous salpingitis.

The membranes covering the fœtus are the same as when pregnancy occurs in the uterus. The development of these membranes, the placenta, and the fœtal circulation proceeds as in normal pregnancy until their growth has proceeded to the utmost limit of distention of the tubal structures, which rarely goes beyond the twelfth week. Rupture may take place into the peritoneal cavity, producing the death of the mother in nearly all cases from hemorrhage, shock, or peritonitis unless relieved within a few hours by the surgeon. Rupture not infrequently occurs into the folds of the broad ligament, when the fœtus generally dies, and the resulting hæmatocele, if circumscribed by the folds of this ligament, may subsequently absorb and the patient recover. In these cases, if the umbilical cord is not broken or the placenta detached, the fœtus may go on developing until a second rupture takes place in the peritoneal cavity, or

it may possibly distend the ligamental envelopes and develop to full term. This may possibly occur either in the folds of the broad ligament or into the peritoneal cavity. The fœtus has been known to drop entirely out of the fimbriated end of the tube and develop free from any except its own coverings in the abdominal cavity. When this occurs it excites an active proliferation of connective tissue by means of which a secondary sac is formed for its protection, though cases have been reported where the child, upon operation, was found entirely free among the intestines. As the placenta has grown in the latter months of pregnancy it has formed attachments to vascular abdominal viscera, making separation at an operation for the delivery of the child one of the most dangerous and formidable performances in surgery. Where the placenta retains its attachment in the tube after the rupture and discharge of the fœtus, if development proceeds uninterrupted by this accident, the condition is described as tubo-abdominal pregnancy. Cases have also been described as tubo-ovarian pregnancy.

The **symptoms** are much the same as in normal pregnancy. The menses are usually arrested, though they may keep on in a modified form for one or two months. In some instances a more or less continued sanguineous discharge from the uterus has kept up continuously for several weeks. The uterus enlarges, the mucous membrane is transformed into a decidua, and a mucous plug usually forms in the cervix. There are frequently no signs to indicate the occurrence of tubal pregnancy until rupture occurs. In most cases where its presence has been revealed the discovery has been made by accident. Certain abdominal conditions or sensations have prompted the patient to seek an examination and opinion about her condition, and the characteristic painful, fluctuating tumor has been discovered by the side of the uterus. As the fœtus develops in the tube its presence is revealed by digital examination. Impending rupture from the eighth to the twelfth week causes paroxysmal pains which are characteristic. Associated with this there are uterine pains also, with discharges of blood and shreds of the deciduous membrane.

The symptoms which denote that rupture of the tube has taken place are a sense of bursting or tearing pain, faintness, rapid pulse, vomiting, subnormal temperature, yawning, a sense of sinking and collapse, with cold, clammy perspiration. If the patient survive these symptoms, she may recover from her acute anæmia as she would from an hæmatocele. If the ovum dies as a result of the rupture, the effused blood may gradually absorb and a slow recovery occur. If, however, the vital connection of the fœtus with the maternal parts was not separated at the time of primary rupture, it may continue to grow between the folds of the broad ligament or in the secondary cyst provided by nature to wall it off from the peritoneal cavity. As it develops secondary rupture may occur, producing far more serious effects than at first, resulting in the great majority of cases in the death of the patient from hemorrhage, shock, or peritonitis.

Course and Termination.—A ruptured tubal pregnancy was formerly thought to be a fatal accident. It is now known to occur frequently in the early months. Many of the hæmatoceles and broad-ligament hæmatomata are now known to have originated from ruptured tubal pregnancy. When these ruptures occur into the folds of the broad

ligament, patients usually recover in the same manner as they do from a pelvic hæmatocele. Tubal pregnancy rupturing into the abdominal cavity usually causes the death of the patient from loss of blood or peritonitis. Where the hemorrhage is not at first fatal and reaction occurs sufficiently to permit an operation, proof of the real nature of the accident is sometimes only found by discovering the chorionic villi under the microscope. If the fœtus should survive the first rupture of the tube, it may go on developing until it reaches full term. A spurious labor may come on; deciduous membrane and blood may be discharged from the uterus; the child will die unless removed by the surgeon, and may become mummified and form a lithopædion, and may be retained in the abdomen of its mother for any number of years. It may cause a great variety of abdominal disturbances—such, for example, as obstruction of the bowels, interference with the kidneys, peritonitis, and septicæmia. It may ulcerate through its envelopes, decompose, and the fœtal bones may penetrate any of the abdominal viscera. They have been discharged in considerable quantities through the bladder, vagina, rectum, and abdominal walls.

The **diagnosis** of tubal pregnancy in the early months is at all times difficult and frequently impossible. Many cases present no symptoms whatever until rupture of the distended tube takes place, which is accompanied by pain and all the evidences of internal hemorrhage and collapse. These may be the first signs of any abnormal condition. Should evidences of pregnancy attract attention, and suspicion be excited by unusual pains or other abnormal symptoms, an examination might disclose the fact that the uterus was empty and that a soft, painful fluctuating tumor existed by the side of that organ. The discovery of these conditions would almost ensure the diagnosis. It is true that tubal cysts from other causes occur, which might confuse a diagnosis, but they would be unaccompanied by the signs of pregnancy.

Characteristic pains, the expulsion of a deciduous membrane, and more or less continuous sanguineous discharge from the uterus are the usual signs of tubal pregnancy. The discovery of an empty uterus and a growing tender sac by its side ought in a majority of cases to make a diagnosis tolerably certain. In some cases, however, a differential or accurate diagnosis can only be made out after operation by the discovery of chorionic villi by the microscopist.

Extra-uterine pregnancy is very difficult to differentiate before, and sometimes impossible even after, operation. But take all the signs together if looked for, and the significance of each carefully considered, a diagnosis ought to be made in most of the cases when suspicious symptoms have led to an examination. Great care should be exercised in making these examinations not to rupture the cyst. This accident has occurred in the hands of some justly distinguished men.

The **treatment** of extra-uterine pregnancy varies according to the condition of the fœtus and the stage of pregnancy. Three varieties are named by most authors: (1) Tubal pregnancy previous to the third month; (2) after the third month with a live child; (3) cases prolonged after the death of the child. The indications for treatment vary according to the actual condition of the patient. If rupture of the tube has occurred into the peritoneal cavity and hemorrhage is going on, absolutely nothing but an immediate laparotomy can save her life. It is just as

necessary to cut down upon and tie the bleeding vessels in the case of ruptured ectopic pregnancy as it would be to perform the same operation for any hemorrhage in any other part of the body. The condition of a woman with a ruptured and bleeding tube is a desperate and usually fatal one. When the tube ruptures into the folds of the broad ligament, or the effused blood is circumscribed by walls confining it to a compartment by itself, no treatment is required, except to put the patient in bed and carefully watch for the occurrence of any serious symptoms. In this class of cases the quantity of blood lost is not great. Should any symptoms arise indicative of further hemorrhage or septicæmia, an immediate operation becomes necessary. In case no symptoms arise this effused blood may be left to absorb, which, if the fœtus be dead, it is likely to do in the course of a few weeks. Should the fœtus survive the rupture and development continue, hemorrhage is likely to occur again from a second rupture through its partition walls into the peritoneal cavity, creating the same indication as at first for immediate cœliotomy. Many women are saved by this operation. Most, if not all, might be if skilfully operated on at the right time.

The operation is not difficult, there being no adhesions and no complications. The woman is generally in good condition, not having been exhausted by previous disease, pressure from a growing tumor, or long confinement to the house or her bed. If collapse has occurred from shock or loss of blood, a reasonable time should be allowed for reaction to take place, but if the patient is getting worse instead of better, no delay should be permitted, as it will be impossible to bring about reaction in an exhausted woman while hemorrhage is still going on. If anything is to be accomplished in a case of internal hemorrhage arising from this cause, delaying for the purpose of bringing about reaction is the simplest kind of folly, unless the hemorrhage has been arrested by natural processes. The very means used for the restoration of the patient will be the ones most likely to increase the hemorrhage. Here, as everywhere else, absolutely nothing will do but to cut down upon and tie the bleeding vessel. Without much delay for preparation or for removing the patient to better quarters in a hospital the abdomen should be opened. If he is reasonably certain that hemorrhage is still going on, the operator should seek at once for the uterine end of the tube and tie it securely, removing the clots, washing out the abdomen, and leaving in a drainage-tube.

Where the diagnosis is certain previous to the third month attempts have been made to destroy the life of the fœtus, thus preventing its further development and the consequent rupture of the tube. It has been proposed to inject solutions of atropine or morphia directly into the body of the fœtus with a hypodermic syringe. Of 18 cases recorded by Lusk, only 3 are known to have ended fatally. Winckel advocates the injection of half a grain of morphine directly through the abdominal wall into the body of the child. He repeats this every six or eight days if necessary: rarely more than two or three injections are required. As soon as the death of the fœtus is secured the pains disappear, the tumor diminishes in size, and the danger of rupture is greatly diminished, if not done away with altogether. This and other similar methods are not to be practised after the fourth month. It has been

proposed also to draw off the amniotic fluid with an aspirator, immediately lessening the distention, and subsequently destroying the child. The faradic current has very strong advocates for accomplishing this same purpose. It is claimed that the tumor will shrink in size after a few applications, thus lessening the tendency to rupture. While morphine, atropine, strychnine, and electrocution may all be employed to kill the growing fœtus, the mother has only been saved from one threatening danger and is left facing another very positive one. While a three-months' fœtus, its amniotic fluid, and membranes may possibly be absorbed, the woman is generally left exposed to dangers of decomposition and septicæmia; also to those of perforation of the viscera, ulceration, and inflammation during the presence in her abdomen of this dead and possibly decomposing mass. With the present perfected technique it is doubtful whether her chances for health and life would not be considerably increased by the early and complete removal of this practically malignant condition. It is quite likely that some of the successes claimed for electricity have been based upon erroneous diagnoses. Brothers, however, has reported 50 cases, 25 of which were in a good state of health from one to eight years after the fœtus had been supposed to have been killed by electricity. Lusk also reports a case in which he is certain that a similar result occurred. Electricity can be employed for the purpose of killing a fœtus from the fourth to the ninth month, thus preventing impending rupture. After the circulation in the placenta has been sufficiently long arrested, an operation for the complete removal of the unruptured gestation-sac, including the placenta, can be much more safely performed. Unless time be a very potent and valuable element in the case, electricity can be given a fair trial, the case in the mean time being under constant observation. A radical operation could be performed at any time should the necessity arise. While a radical primary operation might combine more chances of permanent good than any other form of treatment, cast-iron rules cannot be laid down here any more wisely than for other serious surgical operations.

If no skilful surgeon be present or obtainable, other than surgical methods should be relied upon. The woman might as well run the risks of dying from hemorrhage, peritonitis, or septicæmia as to be killed by bad surgery. If the circumstances of the patient and her environment are all unfavorable to the performance of clean surgery, and she is in the hands of medical men who have never opened the abdomen, the patient's chances would evidently be better to treat her by electricity, hypodermics of morphine into the body of the child, or aspiration of the liquor amnii. By these methods of treatment before rupture time at least would be gained in which to secure the services of a laparotomist or to send the patient to a surgical hospital.

Cases after the Third or Fourth Month.—There is very little difference of opinion among surgeons as to the treatment of cases of tubal pregnancy after the fourth month, or, in fact, after the third. The dangers of rupture are so great that the same radical procedures are to be recommended as are practised in any well-known malignant condition. The thorough removal of the fœtus, its placenta and membranes, should be performed as soon as the diagnosis is settled beyond a doubt. It was formerly taught that it would be safer to stitch the edges of the

opened gestation-sac to the edges of the abdominal incision, and after the removal of the fœtus with its membranes and amniotic fluid to leave the after-birth *in situ* after the ligation of the umbilical cord. If the patient survive the dangers of hemorrhage and septic absorption, she may slowly recover, frequently having an infected sinus leading down into the depths of the imperfectly obliterated cavity. Another practice was to wait until the child had been dead sufficiently long to establish a complete arrest of the placental circulation. In this way it was sought to avoid a fatal hemorrhage which has sometimes attended efforts to remove the after-birth from its very vascular connections.

The period at which an operation could be performed without hemorrhage from the separation of the placenta has never been definitely fixed. Operations have been reported where serious hemorrhage occurred several months after the death of the fœtus. The uncertainties and risks of this course have been dwelt upon by Schauta, who has published a sad array of statistics illustrating the dangers of this waiting policy, where patients were exposed to dangers even greater than those surrounding the modern surgical operation for the removal of the fœtus, such as rupture, leakage from the sac of decomposing material, ulcerations, and perforations of abdominal viscera by fœtal bone, septicæmia, and peritonitis.

In recent literature at least 16 cases have been reported of the successful removal of the living fœtus during the latter months of ectopic gestation. In some cases the ovum was enucleated very much as Minor taught us to enucleate an intraligamentary ovarian tumor. In other cases the vessels have been tied at the side of the uterus under the ovum or placenta, and its removal accomplished with very little hemorrhage. Eastman of Indianapolis in September, 1888, reported a case in the *American Journal of Obstetrics*, vol. xxi., of removal of the entire sac of a tubal pregnancy in the eighth month. Olshausen, Martin, Lusk, Schauta, Taylor, Price, and others to the number of sixteen have similarly operated during the latter half of extra-uterine pregnancy—all with successful results. Harris of Philadelphia has also collected a number of cases. In Lusk's case, while attempting to remove the placenta the hemorrhage was so great that it could only be controlled by compressing the abdominal aorta, after which, enucleation and separation were completed, and the cavity packed until the hemorrhage was nearly controlled. This packing was finally removed, and a Mikulicz pouch inserted and filled with iodoform gauze.

After the Death of the Fœtus.—Although there have been cases reported where the dead fœtus has remained in the abdomen of its mother for periods varying from six months to forty years without serious inconvenience, we cannot safely "leave these cases to nature," knowing as we do the serious consequences which may happen at any time to any one of them. If possible, the fœtus, gestation-sac, and all its contents should be removed according to well-established surgical rules. If there is evidence of decomposition, an attempt should be made to stitch the sac-wall to the edges of the abdominal incision before it is opened, thus preventing its infectious contents from getting into the peritoneal cavity. If there remains a vascular connection of the placenta to the tissues, the question of its removal still remains unsettled. If there is no circulation in it, there will be no trouble from hemorrhage. If its con-

nections are still vascular, the same principle should govern our action in ligating vessels under and around it as when the primary operation is performed.

In a case operated upon by the writer in April, 1893, the woman had gone to full term with a living child which had been dead four months when removed. She had suffered from several attacks of peritonitis, and at the time of the operation was having an evening temperature of 101° F., with a pulse of 120. The ovum, gestation-sac, and placenta were removed unruptured, being enucleated from the broad ligament so easily that when it was lifted through the abdominal incision, with a very slight manipulation underneath it was freed from all adhesions and rolled out on the table. There was no pedicle, and only one small vessel to ligate. The edges of the broad ligament were trimmed down closely and stitched together. The abdomen was quickly closed without irrigation or drainage and the patient put to bed in half an hour. She made a rapid and good recovery, and is now perfectly well. It was found at the operation that the fœtus had developed in the left Fallopian tube until rupture occurred into the left broad ligament; secondary rupture occurred later on, but without further rupture of the gestation-sac, which protruded and which had developed in the peritoneal cavity. This beautiful specimen is now preserved in the Army Medical Museum at Washington.

MINOR GYNECOLOGICAL SURGERY.

By HENRY C. COE, M. D.

It is proposed to present in this article, as concisely as possible, descriptions of the ordinary minor operations performed upon the female genito-urinary tract, the aim of the writer being to avoid confusion by omitting many of the complicated procedures devised by ingenious operators which possess more of a scientific than a practical interest to the general reader. A review of recent special literature must convince one that it is manifestly impossible to make more than a passing mention of these. The last few years have witnessed a remarkable change in the status of minor surgical gynecology in America. There was formerly a prevailing impression, which specialists doubtless sought to foster, that such operations could be properly performed only by pure gynecologists, who were disposed to criticise rather severely those general surgeons who occasionally invaded this field. Moreover, Americans claimed as their peculiar property so-called "plastic operations" on the genital tract, believing that, since the more important ones originated here, it was only in this country that any useful procedure of this character could originate or be perfected. But the broad and liberal spirit of this age has influenced gynecology as well as general surgery, so that we are now prompt to adopt any improvement upon former methods whatever may be their origin. Moreover, there is no fair-minded gynecologist who would deny to his surgical confrère the privilege of performing any special operations, or would withhold the acknowledgment that the latter might do them as well as he could himself amputate a breast or remove a diseased appendix. That a gynecologist is able to repair a lacerated cervix and perineum, or to close a vesico-vaginal fistula, more deftly than a general operator is due simply to the same factors that render the latter more skilful in his own extended sphere—more practice and greater familiarity with instruments and technique. It would be most illogical to infer that because one has had considerable experience in general surgery no special preparation is needed to obtain dexterity in gynecology. Though much may be learned from books, and still more from observation of the work of trained operators, experience can alone supply the necessary skill. The opportunities enjoyed by the hospital interne are unfortunately within the reach of only a limited number of the profession. In default of this, operations on the cadaver and manikin present an invaluable means of acquiring a practical acquaintance with gynecological work. As a teacher of opera-

tive gynecology the writer has been impressed with the ease and rapidity with which students who possess only a rudimentary knowledge of surgery, using the Schultze phantom, acquire such a thorough familiarity with the technique that they can soon be allowed to operate on the living subject. It is to be regretted that we in America, who have such a strong trend toward this branch of surgery, are still far behind the Germans in regard to practical instruction. As long as the erroneous impression prevails among us that any man can become a gynecologist without having served the same preliminary apprenticeship as would be required of a general surgeon, we are not likely to insist upon the same thorough training which is given abroad.

A word of advice to the general reader. It cannot have escaped your attention that the most skilful surgeon is usually the one who has performed an operation in the same way a sufficient number of times to be able to do it well, rather than he who has tried every new method a few times. This is eminently true in gynecology. Choose a few operations which you have found by experience are those which have given you good results, and repeat them over and over again until you can do them well. This is the secret of perfect technique—constant repetition of one method, with the aim to do each operation better than the last one. This does not mean the sacrifice of boldness or originality, since there is always room for the exercise of either, but, other things being equal, the most successful operator will not be the one who is always varying his technique, greatly to the embarrassment of his nurses and assistants. Not being sure of himself or of his operation, there will always be an element of doubt as to his results.

General Considerations as to the Preparation of the Patient, Time of Operation, etc.

While the same rules apply here as in general surgery, certain points should be emphasized.

Contraindications.—Since most of the operations to be described are not life-saving, the presence of organic visceral disease would contraindicate them. One would hardly repair a laceration of the cervix and perineum in a patient with advanced cardiac or renal disease. Too little care is exercised in examining the urine before minor operations, especially in hospitals. The subject of renal insufficiency is one of great importance in this connection, and has only recently received proper attention.

A patient should be kept under observation for some time before operation, the gastro-intestinal tract being carefully regulated. Many a plastic operation has failed because of neglect of the bowels or obstinate vomiting. The diet should be attended to for some days beforehand, being restricted to soups, meat, etc., milk being excluded. The routine use of milk is reprehensible in minor as well as in abdominal surgery.

Anæsthetic.—Ether is generally used, though for shorter operations chloroform (or, better, chloroform and oxygen) is preferable and also causes less vomiting. The latter should never be given except by an experienced anæsthetizer. To entrust it to a nurse or to an ignorant assistant is to risk one's reputation, as well as to jeopardize the patient's

life. The A. C. E. mixture has been highly praised. The writer's experience with nitrous oxide in operations lasting over five or ten minutes has not been satisfactory. The patient is either not sufficiently relaxed or else is profoundly asphyxiated, so that the surgeon's attention is constantly distracted. Local anæsthesia with cocaine is applicable only to minor operations on the external genitals and vagina, such as incising cysts and abscesses; it is useless when applied to the cervix. The same may be said of sprays and freezing mixtures. Divulsion and curettage can be performed without anæsthesia, and even trachelorrhaphy, but the chances are that the operation will not be done thoroughly.

Instruments.—Few instruments are required in minor gynecological surgery, but these should be of the best quality and latest model. It is a common error to buy them of travelling agents and second-rate firms simply because they are a little cheaper. This is not only more expensive in the long run, but such tools invariably bend or break in the hour of need. Since they are longer and more delicate than those ordinarily employed in general surgery, special training and dexterity are required in order to use them properly. Note that the scissors should cut at the *points* and should be finely tempered. Metal handles should be used for all instruments, so that they can be sterilized.

Needles.—Of these the surgeon should have a full assortment, remembering that those with sharp cutting edges are to be discarded. For operations on the cervix Emmet's trocar-pointed, straight and curved, are the best. A long, slightly-curved needle with a short hypodermic point is useful in operations on the perineum and vagina. Short, blunt-pointed needles are used in closing fistulæ. The ordinary straight, blunt-pointed sewing needle is preferred by some for perineorrhaphy. All the various suture-materials are used in gynecology, silkworm gut being the best all-round suture, though silver wire is preferable in trachelorrhaphy and amputation of the cervix.

Sponges.—Small sponges in holders are used, though balls of sterilized absorbent cotton or gauze are better. Some surgeons employ constant irrigation, but this is not always practicable in private work, and is embarrassing to an unskilled operator. Boiled water, saline, or Thiersch's solution should be used in preference to carbolic and bichloride.

Assistants.—It is commonly believed that any one can assist at a minor gynecological operation; there is no greater error. Even an expert is hampered by the presence of one not familiar with his work. One assistant and a nurse, besides the anæsthetizer, are usually sufficient, except for curetting, where a single assistant is enough. By using a self-retaining speculum with the patient in Sims's position, or a leg-holder when she is in the dorsal posture, an extra hand can be dispensed with. The main duty of the assistant is to keep the field of operation free from blood without interfering with the operator, which requires constant sponging. The proper holding of tenacula, sutures, etc. can only be learned by experience. A nurse accustomed to the operator's methods is indispensable to neat and rapid work, and is much more useful than a physician not trained in gynecology.

Preparation of the Field of Operation.—It is only within a comparatively short period that aseptic technique has been applied to minor

gynecological surgery. The female genital tract was almost the last to receive this attention, the most careful surgeons feeling that their whole duty was done when an antiseptic vaginal douche was given prior to operation. Unfortunately, this custom still prevails to some extent in private practice. Septic infection and failure were a necessary result. Patients used to die of sepsis after trachelorrhaphy, and even after perineorrhaphy. While this subject has been thoroughly discussed elsewhere, its special application may be emphasized here. The external genitals should be shaved if possible. Private patients may object to this, but the hair can at least be clipped short. The parts are first thoroughly scrubbed with tincture of green soap and water; then the vagina is scrubbed with the same by means of a soft plate-brush or cotton swab. Then irrigate with boiled water, wash with alcohol, then with bichloride, 1 : 1000, and again with boiled water. Ten per cent. creolin-mollin is a favorite application. It is good practice to wash out the lower bowel with boric or Thiersch's solution in operations for lacerated sphincter, also the bladder in operations on this viscus; in short, the same aseptic precautions are to be observed in a simple curettage as in a vaginal hysterectomy. By adopting this rule the surgeon may always feel sure that he has secured the most important guarantee of success.

General Precepts.—In addition to a perfect aseptic technique, the surgeon attains success in gynecological surgery by remembering the following cardinal rules: First, have at the outset a clear idea of what is aimed at in the operation, both immediately and remotely; second, perform the operation with which you are most familiar and which you can do *well;* third, do not remove too much tissue, and be sure that opposed raw surfaces can be exactly approximated before introducing the sutures; fourth, do not use too many sutures and do not tie them too tightly, remembering that they are not cosmetic effects at which you are aiming, but permanent results; fifth, give your personal attention to the preparation and after-treatment, especially the care of the bladder and bowels; sixth, do not remove the sutures too soon, unless they are actually cutting or suppurating. Let the wound alone as far as possible, as in general surgery. Finally, remember that experience and frequent repetition alone render one an expert operator. Do not sacrifice anything to *time*. Operate deliberately. A further caution may be added: Do not attempt new and complicated plastic operations with which you are familiar only from descriptions. A long apprenticeship is necessary before one can do this with success. This applies particularly to urethral and bladder work, in which few gynecologists are experts.

Do not regard your work as finished when the stitches are removed. Keep the patient under observation, and supplement your surgical treatment by carefully regulating the general health and by further local treatment—the insertion of a pessary, etc.—when indicated. With this brief introductory we shall take up the various operations in order.

A natural and convenient division of this article is suggested by the anatomical relations of the pelvic organs—*i. e.* operations on the external genitals, on the vagina, on the uterus, and on the urinary tract. These may be further subdivided into operations for the cure of congenital anomalies, for the results of traumatism, immediate and remote, for herniæ or displacements, and for the removal of neoplasms.

Operations on the External Genitals.

Congenital Anomalies.—With a few exceptions these seldom call for surgical interference. In cases of hermaphroditism an existing epi- or hypospadias may be cured by a plastic operation, which will be described under Affections of the Urethra. Atresia of the vulva may be either congenital or the result of previous inflammation. In young children the nymphæ, and sometimes the labia majora, are firmly united from behind forward, even as high as the meatus, attention being directed to the condition by difficult micturition. In some cases the adherent labia may be pulled apart with the fingers and a tampon inserted until the opposed raw surfaces are healed. In others it may be necessary to introduce a director and to divide the bridge in the median line. In older subjects the atresia may first be noticed through its interference with menstruation or coition. Senile vaginitis is an occasional etiological factor in women who have passed the menopause. In such patients a more satisfactory result would be obtained by uniting the edges of the raw surface on each side with fine sutures, or even by excising strips of tissue, as suggested by Mundé, the vaginal orifice being subsequently kept open by a glass dilator.

Hernia and Hydrocele.—Although these conditions are fully treated elsewhere, it is important to consider them briefly from a gynecological standpoint.

Pudendal Hernia.—This corresponds to inguinal hernia in the male, and descends along the round ligament to the upper portion of the labium majus. It is rarely double. The occurrence of hernia after Alexander's operation will be referred to later. The protrusion in the labium is usually somewhat elongated or pear-shaped. Within the hernial sac may be found not only intestine and omentum, but an ovary, and even the uterus, gravid or non-gravid. Hernia of the intestine may be due to injury or violent muscular efforts, as in the male, but the symptoms are less pronounced and strangulation is quite rare. Discomfort and localized swelling generally attract attention to the hernia, which, if near the external ring, may be mistaken for hydrocele or tumor of the round ligament; when in the labium, for a neoplasm or inflammatory swelling. The history of the case, the absence of evidences of inflammation, the impulse on coughing, the tympanitic percussion-note, and the disappearance of the tumor on making taxis should prevent error, though it may occur in a superficial examination. The possible coexistence of hernia with a cystic or inflammatory swelling should not be overlooked.

Hernia of the ovary is recognized by the periodical enlargement and tenderness of the hernia, with the usual symptoms of ovarian trouble. Taxis is best performed with the patient's hips elevated (or in Trendelenburg's posture), a truss being fitted so that it will press from below upward against the external ring: it will be difficult to keep it in position without a perineal band. Strangulated inguinal hernia is treated as in the male. If a displaced ovary cannot be reduced and kept in position, it may be necessary to remove it with the tube (which is often diseased), which is easily done by a direct incision into the sac, a double ligature being applied to the pedicle as in an ordinary oöphorectomy.

If the pregnant uterus becomes incarcerated, it may be possible to replace it after inducing abortion, otherwise extirpation of the organ is indicated.

Hydrocele of the canal of Nuck is described by gynecological writers as an extremely rare affection, though Coley has shown that it is less so than was formerly supposed. It consists of an accumulation of serous fluid in the canal, which may communicate with the peritonal cavity or may be encysted. Unless it results from traumatism, it appears as a slow-growing swelling, which is first noticed at the external ring and gradually extends down into the labium majus, disappearing under manipulation or when the patient is placed on her back. As distinguished from hernia, it develops slowly, is elastic, translucent, flat on percussion, while the characteristic fluid is obtained on introducing a hypodermic needle. As the result of traumatism or inflammation the contents may become bloody or purulent.

The treatment of this condition differs according as the hydrocele has become encysted or still communicates with the peritoneal cavity. In the former condition aspiration is occasionally curative, or it may be followed by the injection of a little tincture of iodine to promote adhesive inflammation. To the surgeon a free incision commends itself as the preferable procedure, a portion of the wall of the sac being excised and the cavity packed with iodoform gauze and allowed to heal by granulation. Better still is dissection of the cyst *in toto*, which the writer has performed with entirely satisfactory results, the process of peritoneum being ligated and the external ring sutured to prevent subsequent hernia.

FIG. 357.

Elephantiasis of vulva after operation (Schroeder).

HYPERTROPHY.—Simple hypertrophy of the clitoris may result in such an enlargement as to require surgical interference. The organ may be removed with the knife, scissors, or galvano-cautery, the latter being preferable on account of the profuse hemorrhage which often occurs. This can usually be controlled by deep sutures, however, so that union by first intention may be obtained.

ELEPHANTIASIS leads to the most marked hypertrophy of the labia majora (more rarely the nymphæ), which may weigh several pounds and cause such interference with sexual intercourse as to require removal. The operation is necessarily a bloody one, and belongs rather to the general surgeon than to the gynecologist. With the view of controlling hemorrhage it has been suggested to transfix the base of the tumor with long pins, over which is twisted a temporary rubber ligature, or to insert deep provisional sutures of silver wire, which are tightened after the

mass has been excised and the vessels ligated. The galvano-cautery loop has also been used successfully. But these methods seem to be better applicable to malignant neoplasms, in the case of which the extensive removal of diseased tissue is the principal object aimed at. As it is desirable to restore the parts as nearly as possible to their normal condition, Schroeder's method of removing hypertrophied labia is preferable. Beginning the cut behind the posterior commissure, an incision is carried around the base of each labium in turn, the edges being united by deep sutures as the operator proceeds, any undue loss of blood being thus prevented. A prolongation of the incision upward on to the mons enables one to remove the enlarged clitoris.

NEOPLASMS.—Surgically these are distinguished as benign and malignant. The former include cysts, connective-tissue tumors, angiomata, etc.; the latter, carcinoma, sarcoma, and lupus. Their surgical treatment is subject to the same rules which apply to the removal of similar neoplasms in other parts of the body—*i. e.* in the case of malignant growths to carry the incision as far as possible beyond the limits of the disease, even with the result of causing a tedious granulating process and extensive cicatrization; in removing innocent tumors to spare the surrounding tissues and to avoid subsequent deformity.

Cyst of the vulvo-vaginal glands is readily recognized as a tense, elastic swelling, varying in size from a marble to a hen's egg, situated in the posterior part of the labium. If in the gland itself, such a cyst is deep seated; if in the duct, it appears to be just beneath the mucous membrane. Cysts are located more posteriorly than hydrocele, and, unlike the latter, bear no relation to the external ring, while their circumscribed character, fluctuation, absence of impulse, and irreducibility should sufficiently distinguish them from hernia. When they reach such a size as to interfere with coitus or otherwise to cause discomfort, their removal is necessary. Aspiration and the injection of irritating fluids into the sac are unsurgical. If possible, it should be excised under local or general anæsthesia. But the wall is often so fragile that only a portion of it can be removed: in this case the cavity is packed with gauze and allowed to granulate in the usual manner. Pozzi has described an ingenious method of withdrawing the cyst-contents and injecting melted paraffin, which is then hardened by cold applications, when the sac can be excised *in toto*. After this is done the wound is closed with deep tier-sutures of catgut.

Abscess of the vulvo-vaginal gland should be opened early by a free incision on the inner aspect of the labium, washed out with pure peroxide of hydrogen, and packed with gauze. In the case of an old abscess with thick, cheesy contents the sac should be extirpated if possible, or thoroughly curetted and cauterized.

Vegetations or *condylomata* of the vulva, which are usually, though not necessarily, of specific origin, may require removal even during pregnancy: this is best effected in the case of the smaller growths by the curved scissors, the wound being touched with the Paquelin or galvano-cautery. This little operation can be done under local anæsthesia. If the growths are larger and pedunculated, they may be tied off or removed with the galvano-cautery, as the hemorrhage is apt to

be profuse, the patient being anæsthetized. The same course is to be followed in the case of urethral caruncles.

Benign growths most commonly found in this region, fibroma and lipoma, may be either diffuse or polypoid, and their treatment varies accordingly. Tumors originating in the labia, mons, or beneath the skin of the perineum may attain a considerable size without altering the relations of the parts, by reason of the great laxity and distensibility of the subcutaneous tissue. They may become firmly attached to the rami of the pubes, and thus simulate periosteal sarcoma. Rarely, they develop in the ischio-rectal fossa and extend upward to the vulva. The smaller growths may be readily shelled out through an incision made directly through the skin covering them. If, as often happens, the skin is redundant or is closely adherent to the subjacent growth, an oval piece of the former should be removed by the usual elliptical incision. When the tumor is adherent to the bone, branches of the pudendal artery require ligation, while division of the corpora cavernosa of the clitoris gives rise to free hemorrhage. If there is a thick pedicle, it may be divided with the cautery, though the use of a temporary rubber ligature is preferable, to be replaced by catgut, in order to secure primary union. Oozing is readily checked by tier-sutures. If the wound is deep, especially in stout subjects, a gauze or rubber drain may be inserted at its lower angle. Should suppuration occur, frequent irrigation with peroxide of hydrogen and repacking hasten the granulating process.

Polypoid tumors are easily removed with scissors, large pedicles being divided with the galvano-cautery loop or secured with rubber or mass-ligatures, and their edges united with sutures of silkworm gut. The prognosis in these cases is good, although primary union cannot always be expected on account of the extent of the wound, the large amount of adipose tissue, and the difficulty of preventing the contact of vaginal secretions, urine, and fæces. The usual occlusion-dressing is applied, covered with oiled silk, and secured with a firm T-bandage. A catheter may be left *in situ* for a few days, or the urine is drawn with aseptic precautions. It will usually be necessary to remove the first dressings earlier than in ordinary cases. On account of the peculiar character of the tissues extensive swelling may be expected; hence the caution not to tie the sutures too tightly. If suppuration occurs, there should be no delay in removing the lower sutures, irrigating, and draining the wound, as extensive sloughing may result if this is neglected.

MALIGNANT NEOPLASMS OF THE VULVA.—The surgical treatment of these growths is palliative or radical according to the extent and limitation of the disease and the involvement of neighboring glands. The prognosis as regards recurrence must always be doubtful, by reason of the rich lymphatic supply of this region and the metastases to adjacent glands, although this is often remarkably delayed. A carcinomatous or sarcomatous nodule on the labium, if discovered early, can be thoroughly removed in the ordinary manner, with the best results. This is especially true of pedunculated fibro-sarcomata. Epithelioma seems to develop more slowly than medullary and scirrhous cancer, and tends to remain localized for a considerable period; hence the importance of early and thorough removal. It usually begins between the greater and lesser labia, less often in the clitoris, as a small nodule giving rise to

ning or burning sensation, assuming later the characteristic raspberry cauliflower appearance. On account of its location and contact with tating secretions it tends to ulcerate early, bleeds freely, and gives to an ichorous secretion. Pain is often absent until a later stage, the general health is little affected. The natural duration of the ease is two or three years—a point to be remembered in advising rative interference. The rule to carry the line of incision well ond the diseased tissue applies especially to epithelioma of the vulva: ether the recommendation to excise enlarged inguinal glands or not o be generally followed is doubtful, since when these are extensively cted it may be safely assumed that the deeper glands are already eased. In an apparently favorable case of primary epithelioma of mons Veneris in which the writer could detect no glandular involve- nt intrapelvic recurrence took place in a year after thorough excision the growth. If possible, union by first intention should be secured, sutures being introduced as described under the head of Elephant- s, hemorrhage being controlled by deep sutures rather than by the of the cautery; but if there is any doubt as to the removal of all the eased tissue, it is better to cauterize freely and to allow the wound to nulate. Extensive defects or subsequent deformity from cicatriza- n can be repaired by a plastic operation, immediate or secondary. In case of diffuse growths involving the vestibule resection of the lower of the urethra may be necessary, when care must be exercised to vent subsequent stenosis. The palliative treatment of inoperable es consists in vigorous curettage with the sharp spoon, followed by terization and subsequent applications of powder, equal parts of der- tol or iodoform and tannin being useful for this purpose. The ulcer- ng surfaces should be kept clean by the frequent use of peroxide, ons of creolin, thymol, etc., pain being relieved by anodynes.

Lupus is more amenable to treatment than carcinoma. The disease uld be eradicated by a cutting operation if possible, otherwise the of the sharp spoon and caustics is indicated. Chloride of zinc finds seful application in all those cases in which union by first intention ut of the question.

Clitoridectomy.—As before stated, the clitoris may be the seat of ple hypertrophy, either congenital or in consequence of prolonged tation (masturbation, nymphomania, etc.). Neoplasms, though rare, e been observed. Elephantiasis, chondroma, etc. may cause marked argement of the organ. Nearly every gynecologist has encountered or more cases of epithelioma in this region. While the indication removal of the enlarged clitoris is sufficiently clear, its extirpation the cure of genital irritability is regarded as of more than doubtful ity. A few successful cases have been reported, but the experience most operators has been that the relief is only temporary, the sensitive a being subsequently transferred to some other spot in the neighbor- d. Morris's suggestion to strip off the adherent prepuce in these es is a good one, and should always be tried, especially in the case of ldren. It is readily effected with the finger-nails or the point of a be or director, under cocaine anæsthesia. Removal of the moder- y enlarged clitoris is performed with curved scissors, the organ being wn forward with a small volsellum or bullet-forceps and dissected out

from the prepuce. The hemorrhage is readily controlled with deep sutures and a compress. The arteries retract, and can seldom be caught and tied separately. When it is enlarged from simple hypertrophy, or is the seat of a benign neoplasm, the base is ligated and the mass excised. In dealing with a malignant growth not only should the dissection be more extensive, but it is desirable to cauterize its bed thoroughly. The urethra should be depressed with a sound and carefully isolated before removing the mass.

Hyperæsthesia and Kraurosis Vulvæ.—These conditions should be alluded to, as they are sometimes treated surgically. Hyperæsthesia of the vulva is a condition of abnormal sensitiveness of the vulvar mucous membrane, described by Thomas, not associated with any visible lesion. It is exceedingly intractable, and, although removal of the affected mucosa has seemed to promise relief, the results have not justified the expectations of those who have practised it. In the writer's experience the starting-point of the trouble will often be found in a small painful cicatrix or group of minute angio-neuromata at the edge of the hymen, excision of which in two instances effected a cure in his hands. In removing such tissue it is advised to introduce fine sutures parallel with the long axis of the vagina, in order to secure primary union and to prevent the formation of a second painful cicatrix.

Kraurosis is a peculiar affection, first described by Breisky, who operated for it successfully and has had several followers. It is characterized by the appearance of sensitive red spots on the inner aspect of the nymphæ, with progressive atrophy of the mucosa and resulting stenosis of the outlet, so that coitus becomes painful or impossible. Local applications are useless and cauterization of doubtful benefit. The condition has been cured by complete excision of the diseased areas, the edges of the wound being united by fine interrupted sutures, as after the removal of a neoplasm.

Traumatic Lesions.—Wounds of the vulva may be either incised or contused according as they are made by a sharp or a blunt object. They also differ in their character and seriousness as they occur in the pregnant or non-pregnant. In the latter class of patients they may be due to direct violence, as a stab or kick, or may result from accident, such as a fall upon the rail of a fence, the back of a chair, or a pointed stick. In fatal cases important medico-legal questions may be involved. Incised wounds are often followed by hemorrhage so profuse as to endanger life unless it is promptly arrested. They are dealt with according to the ordinary surgical rules, bleeding points being ligated and venous oozing checked by tampons and compresses, the wound being enlarged if necessary. The recommendation of many authors to control obstinate venous hemorrhage by the application of styptics or the actual cautery is of doubtful utility, in view of the subsequent sloughing which is almost inevitable. Deep sutures are preferable. These should be of silkworm gut or, better, of silver wire, and should be passed beneath the entire bleeding surface. They may be reinforced by tier-sutures of catgut.

The rupture of varicose veins of the vulva during pregnancy, and more especially during labor, is an accident which may result fatally if not promptly treated. In the less severe cases the bleeding can be

arrested by a firm compress, but it is advisable not to lose any time in seizing the bleeding points with clamps if possible, and introducing deep sutures, which are tied or twisted; then a compress is applied with a firm T-bandage. The writer met with a case of incised wound of the vestibule (from obstetric forceps) which bled so profusely that it was mistaken for post-partum hemorrhage, and the uterus was tamponed. It was readily controlled by a continuous silk suture.

Subcutaneous laceration of the pudendal vessels gives rise to hæmatoma, the size and rapidity of development of which depend upon the extent of the lesion. It is naturally more extensive in pregnant women. Should the tension be so great that the tumor ruptures, the case resolves itself into one of primary pudendal hemorrhage, and should be treated as before described.

A hæmatoma which develops gradually gives rise to throbbing pain, with sometimes difficult micturition from pressure on the urethra. The sudden appearance of the swelling and the absence of inflammatory symptoms will serve to distinguish it from abscess, œdema, or hernia.

A small collection of blood is usually absorbed spontaneously, and requires no treatment beyond rest and cooling applications. The judicious use of an ice-bag in non-pregnant women is to be recommended. In puerperæ there is considerable danger of suppuration, and as soon as this occurs the patient should be anæsthetized, a free incision made on the inner aspect of the labium, the clot turned out, and the cavity irrigated with peroxide and packed with gauze, as in the treatment of an ordinary labial abscess. The same treatment is applicable to a large clot which has shown no sign of absorption after several days, even though it is not inclined to suppurate. Free oozing may occur after the clot is removed, but it is seldom so obstinate as to resist firm tamponade. The gauze should, of course, be changed at intervals of two days, or more frequently if necessary, the cavity being syringed out with an antiseptic solution—creolin, carbolic acid, or Thiersch's.

Operations on the Perineum.

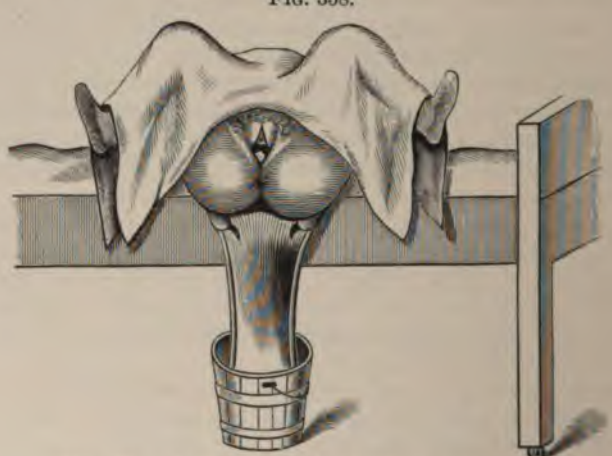
The operation of perineorrhaphy as now performed is really colpoperineorrhaphy, including the posterior vaginal wall as well as the vulvar outlet. The repair of the perineal laceration alone is mostly confined to suture of the fresh tear.

It is hardly necessary to call attention to the anatomy of the perineum and pelvic floor, the former being merely that portion of the floor which lies beneath the anus and the lower end of the rectum and the vulvar commissure. The pelvic floor itself is made up of the fibres of the levator ani muscles and the two layers of fascia which embrace the vagina and rectum and furnish support to them. The perineum proper is rarely injured by external violence, but it may be torn during coitus or by accident, such as falling on a sharp body. The ordinary lesions due to childbirth vary from a slight superficial tear to a deep laceration involving the sphincter ani, extending from half an inch to two inches up the recto-vaginal septum. Perforation of the perineum, or central rupture during delivery, is a rare injury which may be regarded as practically an ordinary tear. Beside the ordinary lesion there may be a peculiar

relaxation of the vaginal outlet and pelvic floor due to submucous laceration or overstretching of the deeper tissues, without visible injury.

Superficial Tears.—The treatment of these is quite simple. The invariable rule should be that injuries of the perineum, with the exception of slight nicks in the fourchette, should be sutured at once, with the object of preventing possible septic infection and obviating the necessity of a subsequent operation. The primary operation is to be performed immediately after delivery, unless in those cases in which the patient is so exhausted by a severe obstetrical operation that prolonged anæsthesia is inadvisable. If she has not been anæsthetized, it is not necessary to do so, since the tissues are already so benumbed by long pressure that but little pain is experienced. Even in the present age of aseptic surgery the caution is not superfluous to preserve the strictest antisepsis. The most careful accoucheur is apt to be somewhat careless about the details of this little operation, while most men think that they are sufficiently careful if they take loose instruments from the obstetric bag, a needle from the case, and throw them into a dish of carbolic-acid solution, in which the sutures are also dipped. This practice is not only the cause of many mild cases of sepsis, but accounts for frequent failure of union, which ought rarely or never to occur. The operation is simple. The patient is drawn down to the edge of the bed and placed upon a Kelly pad, or piece of rubber sheeting, the flap of which rests in a slop-pail or foot-tub (Fig. 358). The

FIG. 358.



Disposition of patient on the bed for the recent operation.

knees are supported by a nurse or other assistant. The operator, after thoroughly disinfecting his hands and boiling his instruments, rolls out the parts under a good light, so as to note the exact extent of the injury. The field of operation is usually obscured by oozing; therefore constant irrigation with boiled water is an advantage, or, in the absence of this, the parts may be sponged with pledgets of absorbent cotton dipped in sterilized water or creolin solution. A temporary gauze tampon introduced into the vagina will absorb the uterine discharge. It should be the

object of the accoucheur to do the operation so thoroughly that a subsequent one will be unnecessary. To this end he must aim at perfect approximation of the raw surfaces by sutures passed deeply beneath them. The mere apposition of the torn edges of the skin is worse than no operation at all, since a pocket is left behind the "skin perineum" in which the lochial discharge collects. It should be remembered that these tears usually begin in the posterior vaginal wall from one to two inches from the outlet; therefore it will generally be necessary to place one or two sutures in the vagina. A curved needle is preferable to a straight one for the operation. The writer prefers a round needle with a hypodermic or trocar point and having a large curve. Since the recto-vaginal septum is apt to be very thin, it is better to insert the middle finger of the left hand into the rectum, the other fingers serving to hold aside the lips of the vulva. Having introduced two or three vaginal sutures if necessary, the external sutures are passed, the needle being introduced close to the left edge of the wound, including as little skin as possible. It is then swept around to secure a strong hold at the side, and is passed across just under the raw surface (the finger in the rectum acting as a guide), and emerges at a corresponding point on the opposite side. Silkworm gut is preferable. If any loose tags of tissue remain, it is better to snip them off with the scissors. Perineal tears are frequently very irregular, especially if forceps have been used, often extending up one or both sulci. Accordingly, it is sometimes necessary to introduce a supplementary row of catgut sutures on either side entirely within the vagina. Chromicized gut is the most useful for this purpose. From three to six sutures are used, according to the extent of the tear. The operator may introduce the upper ones first, or may begin toward the rectal end of the tear. The uppermost suture is the most important one, because it not only brings into apposition the raw surfaces along the labia, but draws down the upper end of the vaginal wound at the same time, to prevent the formation of any pocket. If there is any difficulty in seeing the whole length of the wound, the anterior vaginal wall may be retracted by means of a Sims's speculum. The finger is not removed from the rectum until all the sutures are passed: then, after irrigation of the wound, the operator, having again thoroughly disinfected his hands, ties the sutures in the ordinary manner, the knees being brought together by the assistant. The sutures should not be tied as tightly as in the secondary operation, since the tissues are softer and more likely to swell, and

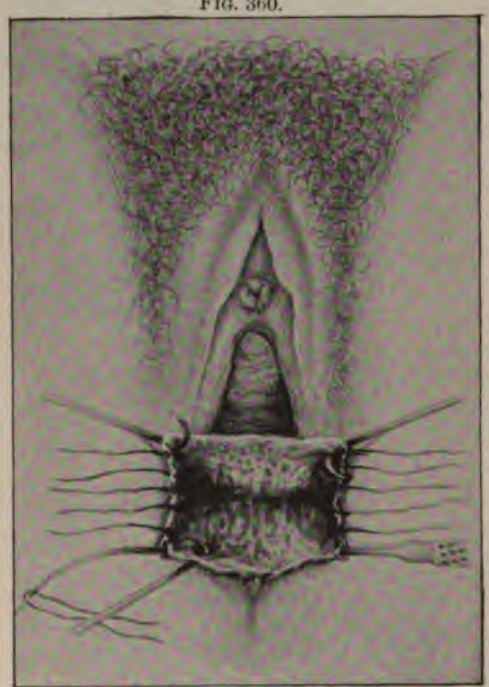
FIG. 359.

Recent tear involving external triangle, requiring internal as well as external sutures.

hence there is danger that they will cut out. The wound is powdered with aristol, sterilized gauze applied, and over this the usual aseptic pad. The patient's knees are loosely tied together, simply as a reminder that she is not to separate them too widely.

The *after-treatment* is quite simple. The patient is allowed to pass her urine, the external parts being irrigated after urination as well as when the pads are changed. The bowels are moved on the third day, as in an ordinary case. The sutures are not inspected until the seventh or eighth day, unless special indications arise, such as complications higher up in the genital tract, an abnormal condition of the lochia, or rise of temperature. They are usually removed on the eighth day, the patient first receiving a vaginal douche, while it is customary to leave the vaginal sutures in position for two weeks, as they seldom cause irritation.

FIG. 360.



Flap-splitting operation for lacerated perineum.

Secondary Perineorrhaphy.—Secondary perineorrhaphy, as before stated, is an operation which is now seldom confined to the perineum alone: when it is, the vulvar outlet is usually contracted in order to furnish additional support after a previous colporrhaphy. The old operation consisted in denuding a surface having the shape of a clover-leaf. All the cicatricial tissue visible being removed, the sutures were then passed as in the immediate operation, the upper suture bringing together the angles of the tear and the upper angle of the wound.

The flap-splitting operation, popularized by Tait, is easily performed, and gives a very good primary result, though it is not applicable to cases in which there is relaxation of the pelvic floor and outlet (Fig. 360). The technique is as follows: The patient being in the dorsal position, two fingers of the left hand are introduced into the rectum; one blade of a pair of angular, sharp-pointed scissors is inserted in the median line midway between the anus and posterior commissure to the depth of half an inch, and a curved incision is made to the left, ending at a point on the anterior edge of the labium majus. The scissors are now turned to the right, and with a single cut a corresponding incision is made. The operator must be careful to avoid buttonholing the vagina or rectum by keeping directly in the middle of the wound. As the wound gapes, a tenaculum is inserted in the centre of either

edge and the cut surfaces are drawn apart, forming a quadrilateral figure, and the spouting vessels are temporarily compressed. A curved needle, threaded with silkworm gut, is entered close to the edge of the wound at its lower margin, and is carried straight across underneath the raw surface. Three or four sutures are sufficient: the upper of these are tied, when it will be found that a flap has been turned up into the vagina. There is usually so much redundant tissue here that it is necessary to excise a portion of it and to bring the edges together with two or three superficial sutures of catgut. The sutures may be inserted still more rapidly by using a modified Peaslee's needle. This method is somewhat different from that described by Tait, who introduces the sutures within the margin of the wound, when of course the skin is not brought accurately together. The operation may be done very rapidly; an expert can complete it in five or six minutes. The subsequent result is usually good, so far as the appearance of the parts is concerned, but the support furnished by such a perineum is often unsatisfactory.

COMPLETE LACERATION.—*Immediate Operation.*—This was formerly regarded as such a severe operation that many obstetricians were inclined to defer it until several hours, or even days, after labor, when the patient was again anæsthetized. There is no doubt that, in spite of the extensive bruising of the parts, primary union is more apt to take place if the tear is sutured at once, while at the same time the surgeon gains a better idea of the nature of the injury than when he waits until the parts have become swollen and œdematous. If proper care is exercised in passing the sutures and in the after-treatment of the patient, failure after the immediate operation should be exceptional. The principal obstacle to a perfect result lies not so much in securing union of the torn ends of the sphincter muscle as in a complete closure of the rent in the recto-vaginal septum.

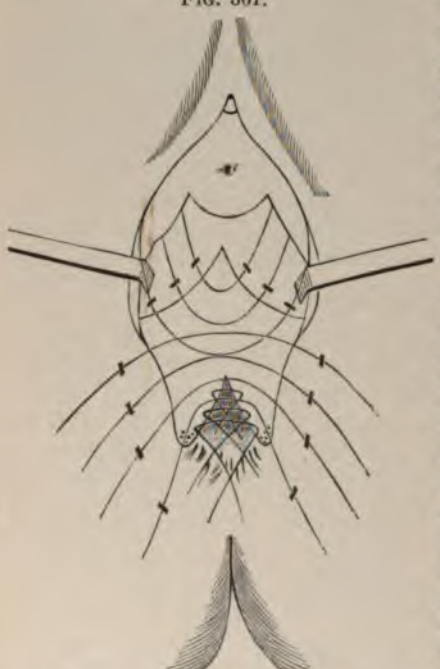
The patient is brought to the edge of the bed, as already described, and the parts are thoroughly exposed, either by the fingers of the assistant, retractors, or a speculum. Constant irrigation is preferable to sponging. The vagina should be previously plugged to prevent fluids from coming in contact with the wound. While his aim is to introduce a sufficient number of sutures to secure accurate coaptation, the surgeon must avoid using so many that the delicate tissues are unduly constricted. Failure is more apt to occur from using too many than too few. When the sphincter alone is involved, the operation is practically the same as in ordinary perineorrhaphy, except that the ends of the muscle are brought together with separate sutures. Two or three are passed directly through the ends of the sphincter, which are previously drawn out by tenacula. They should not extend straight across, but in a curved direction, so as to encircle the anus. After the rectal sutures have been passed the rest of the laceration is closed in the usual manner. When the recto-vaginal septum is involved, a tenaculum should be hooked in the upper angle of the tear, which is drawn upward. Sutures of silk or chromicized catgut are then passed from the rectal side, including the mucous membrane and connective tissue on one side of the tear: they are then passed across and brought out at a corresponding point in the rectum, where they may be tied at the time or after they have all been

inserted. For immediate repair silkworm gut or chromicized catgut answers every purpose. The rent having been closed down to the sphincter, the other steps of the operation are now the same as in an ordinary perineorrhaphy. When the tear involves more of the vaginal surface of the sulci, separate sutures must be used within the vagina.

The *after-treatment* is the same as for the simple operation, the urine being drawn for the first day or two, after which the patient is allowed to pass it. The external parts are irrigated as before. If the bowels are loose, they should be constipated until the third day, the patient being kept on a milk diet. On the third or fourth day the bowels should be moved by a laxative, such as teaspoonful doses of a saturated solution of Epsom salts. Great care is necessary to avoid tearing the wound open by the passage of large scybalous masses. If the evacuation is not sufficiently soft, a rectal enema should be given, consisting of a pint of warm water containing oil or ox-gall. Only the surgeon himself or an experienced nurse should give the enema, using a large soft-rubber catheter while the patient lies on her left side. The sutures may be removed between the eighth and tenth days, especially if they show a tendency to cut out. The vaginal sutures may be left for two weeks.

Secondary Operation (Fig. 361).—The flap-splitting operation already described is particularly applicable to complete laceration. The cicatrix, which is always present in the recto-vaginal septum, is made tense by separating the labia. With a knife, or preferably a pair of sharp-pointed scissors, the edge of the recto-vaginal septum is split to the extent of a quarter or half an inch, forming vaginal and rectal flaps. At each end of the transverse incision another is carried at an obtuse angle forward and outward to the extent of an inch into the labia, and another from the same point outward and backward one-third of an inch, to a point just outside of the end of the sphincter muscle. The vaginal flap is drawn upward with a tenaculum and the rectal flap drawn downward. The ends of the exposed sphincter are now brought together by a suture which sweeps around the lower angle of the wound. The other sutures are inserted as before described. This is the easiest operation to perform, and gives very good results, provided that the ends of the sphincter are thoroughly exposed and accurately brought together.

FIG. 361.



Recent tear through the sphincter.

When the recto-vaginal septum is involved it is better to perform the operation as follows: Having exposed the wound, the cicatricial tissue is entirely removed, and at the same time the surface is denuded for a considerable distance outside of it. The instruments necessary are a pair of mouse-tooth forceps, tenacula, and ordinary curved uterine or right and left scissors. The first strip of tissue removed includes the border of the recto-vaginal tear, exposing the raw edges of the mucous membrane. The ends of the sphincter muscles, having retracted, form little depressions. It is important not only to denude the surfaces over the ends of the muscle, but to actually pull out with tenacula and freshen the ends. The surface denuded will be somewhat triangular, the base being a line drawn through the sphincter. The rectal sutures are now passed from within outward, and are tied on the rectal side. The vaginal wound is closed with sutures of silkworm gut, and finally the ends of the sphincter are coaptated as in the immediate operation. Many surgeons use silver wire. These wire sutures are twisted and cut short and their ends are secured with perforated shot.

Unless the tear in the recto-vaginal septum is quite extensive, the simpler operation now performed by Dr. Emmet gives equally satisfactory results, and avoids the undue tension of the tissue caused by a double row of sutures. The recto-vaginal tear is treated practically in the same manner as in repair of a recto-vaginal fistula, a single row of sutures being passed directly across the vagina down to, but not including, the rectal mucous membrane, the edges of which are allowed to become inverted into the rectum.

One of the principal causes of failure in this operation is the improper preparation of the patient. She should, if possible, be kept under observation for a few days previously, her diet being carefully regulated and the bowels moved daily with laxatives or enemata, the last enema being given at least five or six hours before the operation, so that the lower bowel will be thoroughly cleared out.

The *after-treatment* should be as simple as possible, the main point being the easy evacuation of the bowels, not later than the fourth day. For this purpose it is well to begin the administration of teaspoonful doses of a saline on the morning of the third day. If the bowels have been previously regulated, it ought not to be necessary to administer enemata, the giving of which by a careless or inexperienced nurse or physician is a common cause of failure. Every surgeon has had failures—not only after his first, but after his second or third operation—some due to avoidable causes, others to the carelessness of assistants. Union of the sphincter nearly always occurs, the most frequent accident being the development of a recto-vaginal fistula. If this is small, it may sometimes be closed by cauterization and by keeping the bowels constipated for several days. If it persists, there is nothing to do but to divide the sphincter and to perform the operation again. The beginner is apt to introduce too many sutures, through his desire to bring the parts into perfect apposition. There are a number of modifications of this operation, but the same principle applies to all—to remove all the cicatricial tissue, to bring the edges of the rectal mucous membrane into perfect apposition with the least amount of tension, and to introduce as few sutures as possible.

It is often necessary to combine this operation with posterior colporrhaphy in cases in which there has been a laceration of the pelvic floor as well as of the outlet. A modification of Hegar's operation is most useful under these circumstances. The triangular denudation is simply carried up the posterior wall above the angle of the tear, and the sutures are introduced within the vagina in the ordinary way.

Operations on the Vagina.

Operations on the Hymen.—*Malformations*—Atresia of the hymen is seldom noticed until the establishment of menstruation, when the regular molimen occurs without any discharge of blood. The vagina first becomes distended and causes a bulging of the hymen; later, the uterus dilates, and will be recognized as a globular, fluctuating tumor rising above the symphysis. In a case of long standing in which the tubes have also become dilated the diagnosis of double hæmatosalpinx can be established by palpation.

The **treatment** consists in evacuating the retained blood through an incision in the hymen. It was formerly argued that only a small opening should be made, in order that the blood might escape gradually, since it was feared that the sudden contraction of the uterus and tubes would either force their retained contents into the peritoneal cavity or cause rupture of the tubes. It has been advised that when double hæmatosalpinx has been diagnosed salpingotomy should first be performed. But, while it may seem advisable in cases of extreme distention to evacuate the blood slowly at first, the better method would seem to be to excise the entire hymen and to suture its raw edges, the vagina being thoroughly irrigated with an antiseptic fluid and the vulva covered with an occlusive dressing. The uterus is allowed to contract gradually. Intrauterine irrigation should not be practised unless septic symptoms arise. Should the tubes remain permanently distended, the question of cœliotomy would naturally arise.

Various malformations of the hymen may interfere with sexual intercourse and thus demand surgical treatment. It may have one or several minute openings, or may be firm and unyielding, so that coitus is impossible. Under these circumstances the membrane should be excised close to its base, and the edges united by interrupted sutures of fine silk, in order to ensure union by first intention and thus to prevent the formation of a painful cicatrix. One or two spouting vessels are caught with forceps and twisted or tied.

The *after-treatment* is simple, consisting in irrigation of the wound with boiled water or a weak antiseptic solution, powdering with aristol, and the application of the usual vulvar pad. The sutures are removed at the end of a week, sexual intercourse being forbidden until the parts are entirely healed. Where there are two openings divided by a band it is sufficient to ligate at each end and excise it. It is sometimes necessary to divide or excise the hymen preliminary to local treatment or to obtain more room in a surgical operation, especially in vaginal hysterectomy in an old virgin. Under the latter circumstances, however, episiotomy is usually performed.

Injuries.—*Laceration* of the hymen, especially during the first

coitus, may be so extensive as to require the introduction of a firm tampon or even one or two deep sutures. Cases of arterial bleeding so severe as to threaten the life of the patient have been reported. In a case under the cognizance of the writer a young woman was brought to the hospital on the day after her marriage who had been bleeding all night and was almost exsanguinated. A spouting vessel was readily found and tied.

In *vaginismus* the vaginal orifice is not only exquisitely sensitive to the touch, but contracts spasmodically on attempts at introduction of the penis. In many cases the seat of the greatest sensitiveness will be found along the carunculæ, where numerous small red points and erosions will be seen which simulate neuromata. In other cases the remains of the hymen will be found to be generally inflamed. Small cicatrices following laceration of the vulva may also give rise to a less marked degree of vaginismus. The same reflex contraction of the constrictor cunni and levator ani muscles may be caused by urethral caruncles or fissures, or by fissure of the anus.

Provided that the sensitive area has been positively located at the vaginal orifice and local applications (cocaine, nitrate of silver, etc.) have failed to give relief, the patient should be anæsthetized and the remains of the hymen excised with fine curved scissors. In order to relieve the spasmodic contraction of the bulbo-cavernosi muscles, they should be partially divided by an incision made through them on either side, extending from a point a half-inch to one inch up the vagina to the junction of the skin and mucous membrane. Most operators follow the method practised by Sims of inserting a large glass plug, which is worn until the raw surfaces have healed, when it is introduced for an hour or two every day. It has seemed to the writer that a more permanent result, and with less pain to the patient, is obtained by suturing the edges of the hymen as before described, and partially closing the lateral wounds by sutures introduced parallel with the long axis of the vagina, and then introducing the plug. Coitus should be practised with great caution at first, and, as Mundé suggests, the orifice should previously be anointed with 10 per cent. cocaine ointment.

MALFORMATIONS OF THE VAGINA.—These may be congenital or acquired, the latter being due to disease or traumatism.

Atresia.—This term is properly applied to complete obliteration of the vaginal canal due to imperfect or non-development of the ducts of Müller, the vagina being entirely absent or represented only by a fibrous cord. It has also been extended so as to include cases in which a transverse septum exists at the middle or lower third of the canal. When this septum is incomplete, or contains a small opening, the condition is sometimes distinguished as "incomplete atresia."

The physician's attention will first be directed to the malformation by either the symptoms referred to under the section on Atresia of the Hymen, by the entire absence of the menstrual molimen (in cases in which there is non-development of the uteries and ovaries), or, after marriage, by the impossibility of accomplishing the sexual act.

The presence of a complete transverse septum will be readily recognized by inspection and palpation, and the treatment indicated is the same as in atresia of the hymen.

Complete obliteration of the vagina, in which the external genitalia may be entirely normal, is recognized by rectal palpation, aided by a sound in the bladder. It is important for the examiner to determine accurately whether the vaginal walls are simply fused together, or the canal is represented only by a fibrous cord, or whether the uterus and vagina are entirely absent, since the prognosis as to cure by surgical interference, as well as the risk, become less favorable when there is only a small amount of vaginal tissues remaining. Even in complete absence of the internal genital organs, it may be deemed advisable to attempt the formation of an artificial vagina in the case of a young woman who has married without being aware of her unfortunate condition, though the possible dangers of the operation and the difficulty of keeping the canal open should be clearly pointed out beforehand.

Amussat's operation for the relief of vaginal atresia, or, rather, a modification of it, is performed as follows: With the patient in the lithotomy position, the operator first determines by careful recto-abdominal examination the direction of the obliterated canal, and the condition of the uterus and tubes as regards the amount of distention by retained menstrual blood. A sound is introduced into the bladder and the fore finger of the left hand into the rectum. A transverse incision is made midway between the anus and meatus urinarius. Then, with the right fore finger, aided by blunt-pointed scissors, the surgeon gradually works his way up between the urethra and bladder in front and the rectum behind, gently tearing apart the connective tissue in the median line. When the lower portion of the canal alone is obliterated the obstruction will soon be overcome, the finger will slip into the unobliterated portion of the vagina, and the retained menstrual blood will begin to escape. When, however, the atresia is complete, it will be necessary to continue the blunt dissection until the cervix is reached, when the os is incised, dilated, and the retained fluid allowed to escape, after which the uterine cavity is thoroughly irrigated with an antiseptic solution. To prevent reclosure of the cervical canal frequent dilatation, or the use of a glass or hard-rubber plug for several weeks, is advisable. Having dilated the new canal until it has reached a size nearly or quite equal to the normal vagina, a glass plug is introduced, its lower end being covered with an antiseptic dressing, and held in place by a T-bandage. This plug, which should be of the same calibre as the normal nulliparous vagina, must be worn continuously for one or two months or until the raw surface is completely healed, being removed once daily, when an antiseptic injection is given. Moreover, after this period the patient, if a single woman, should be instructed to wear it for an hour or two every day for several months, until all tendency to contraction has disappeared. In married women there is, of course, less probability that such contraction will occur. In cases of entire absence of the vagina the operation is much more difficult, since the surgeon has no guide as to depth of the dissection without risk of entering the peritoneal cavity, while the danger of wounding the bladder or rectum is greater. Moreover, the artificial canal, which can seldom be made longer than three inches, has such a tendency to contract that it can be kept open only by persistent use of the dilator and with much distress to the patient. When functionally active ovaries are present in the absence of the uterus, oöphorectomy should be performed.

No hemorrhage is encountered during this operation that cannot be controlled by gauze packing, which is subsequently replaced by the plug. The danger of septic infection, once so feared after the evacuation of retained menstrual blood, is now reduced to a minimum.

Various ingenious plastic operations to prevent the canal from contracting have been suggested, such as turning in flaps of mucous membrane obtained from the vulva or dissecting off the labia minora, stitching them together, and uniting them to the raw surfaces within the canal, as practised by Küstner.

Double Vagina.—The vagina may be completely divided by a median septum, the two halves being equally developed or one being of normal size, so that there is no interference with coition or parturition. Under these circumstances no treatment is necessary. An incomplete longitudinal septum interfering with coition is put on the stretch by lateral traction and divided in the middle with scissors or the cautery, hemorrhage being controlled with a tampon. In the case of a thick, vascular band it may be advisable to ligate it at each end and to excise the portion between the ligatures.

Atresia of one or both canals may exist. If one vagina is patent and allows the menstrual blood to escape, no treatment is necessary, but if there is retention in the closed half, spontaneous rupture may occur into the open canal, but under any circumstances the septum should be divided or excised. In double atresia it is customary to open up one side first, and then to divide the septum.

Among other congenital anomalies may be mentioned non-development of the intestinal and urogenital canals, which terminate in a common closed cloaca, and *atresia ani vaginalis*, in which the cloaca of the rectum and vagina has an external opening; or the lower part of the vagina fails to develop, and there is a persistent urogenital sinus. When there is a cloaca common to the rectum and vagina, the malformation has been cured by first establishing an artificial anus and then forming a new vagina or vulva by a subsequent plastic operation. If the anus is normal, but the vagina communicates with the rectum high up, the opening may be closed like an ordinary recto-vaginal fistula.

Herniæ.—Under this head are really included prolapses of the anterior and posterior vaginal walls, though it is customary to regard them as displacements.

True vaginal hernia, or enterocele, is a protrusion of intestine, less often omentum, through the vaginal wall, generally in Douglas's pouch, though rarely between the uterus and bladder. It is usually chronic, and is most common in stout patients with general relaxation of the pelvic floor, and in connection with prolapsus of long standing. It gives rise to no distinctive symptoms, and no instance has been noted in which strangulation has occurred. In the writer's experience it is usually discovered accidentally, and is mistaken for a large rectocele, its true character being recognized by palpation and on replacing the gut. A separation of the muscles at the point of prolapse, often a true hernial ring, will be felt.

The writer has never found it necessary to open the sac, but having made an extensive triangular denudation, as in Hegar's operation for posterior colporrhaphy, so as to include the hernial orifice, he has pushed

up the gut with the peritoneal sac and approximated the edges of the ring with buried catgut sutures. The vaginal wound is then closed with tier-sutures of catgut and superficial silkworm gut sutures, the after-treatment being that of an ordinary colpo-perineorrhaphy. If the operation has been aseptic, a radical cure may be confidently expected. In an aggravated case the sac may, of course, be opened, redundant tissue excised, and the peritoneal edges united with catgut and the muscles and fascia with silkworm gut or silver wire. It must rarely be necessary to open the abdomen in order to cure vaginal enterocele.

Cystocele.—The surgical treatment of this condition is the *bête noir* of gynecologists, since, of all the ingenious operations which have been devised for its cure, not one can be said to accomplish the desired result—permanent replacement of the prolapsed part. This is due not only to the nature of the vaginal walls, which are capable of almost indefinite distention, but to the accompanying conditions—relaxation or laceration of the pelvic floor, prolapse of the uterus, etc. In short, cystocele is merely a complication or result of other lesions, and any operation performed for its relief must be supplemented by others upon the pelvic floor and uterus, or it will be worse than useless. It will be evident to any candid observer that all the procedures to be described consist simply in removing redundant mucous membrane and taking a reef in the anterior vaginal wall. So great is the relaxation of the parts and the amount of pressure brought to bear upon the cicatrix, that the tendency in nearly every case is for the cystocele to recur. The operation is seldom done except as an adjunct to posterior colporrhaphy for obvious reasons, since it is only by bringing the posterior wall upward

FIG. 362.

Oval denudation with sutures passed.

in contact with the anterior that support is furnished to the latter. The usual operations performed are Sims's, Stolz's, and Emmet's.

The preliminary preparations are those common to all vaginal operations, the external and internal genitals being rendered thoroughly aseptic in the manner before described. The patient is placed on her back (though some operators still prefer the left side) on a Kelly's pad, her

legs being flexed and separated by a crutch. Two assistants are necessary. Sponging or continuous irrigation may be employed as preferred.

Sims's Method (Fig. 362).—The posterior vaginal wall being retracted with a speculum, the operator decides beforehand how large a surface he will denude, according to the size of the cystocele, the lateral boundaries being determined by picking up the mucous membrane near each lateral sulcus on a level with the junction of the middle and lower thirds of the urethra, and approximating the two points in order to note the amount of tension. Using sharp-pointed uterine scissors, curved on the flat, he lifts up the mucous membrane at the point on the left, and, while putting it on the stretch with mouse-tooth forceps, removes a strip which curves to the right and ends in the median line at a point from two to three inches from the lower boundary of the wound. A similar strip is removed on the opposite side, so as to mark out an ellipse. The undenuded tissue is now removed, bleeding being checked by forceps, pressure, or irrigation with hot water, and the edges of the wound are brought together at their middle points in order to note the amount of tension. If this is slight and the wound is of moderate size, it is closed with sutures of silk or silkworm gut (from eight to twelve or fifteen) passed just beneath the raw surface an eighth of an inch apart. The writer prefers tier-sutures of catgut, which secure more exact coaptation, relieve undue tension, and need not be disturbed afterward. It is better to use a slightly curved needle with a blunt or not too sharp hypodermic point. Cutting needles cause bleeding, and if used incautiously might penetrate the septum.

In this connection a caution may be added which is applicable to all plastic operations on the vagina. Its walls are thin, and it is desirable to remove only the mucous membrane; hence before denuding a strip of tissue it should be raised with the mouse-tooth forceps (which is preferable to a tenaculum), and kept on the stretch in front of the points of the scissors, the latter being always held parallel with the strip. Moreover, in passing the sutures the point of the needle should follow the same course—*i. e.* it should pass just beneath the raw surface and parallel with it. To secure absolute uniformity between the points of entrance and exit the operator should pick up the edge of the undenuded tissue at the latter and make counter-pressure as the needle emerges. The needle, being grasped just below the eye and held firmly at right angles to the needle-holder, is worked through the tissues gradually with a slight see-saw motion, such as is practised in "basting." If these simple suggestions are followed, the reader will never be obliged to insert his finger into the rectum in order to avoid puncturing the gut, nor will he pass a suture into the bladder and have a resulting fistula—an inexcusable complication of this simple operation.

Stolz's Method.—In this operation a circular denudation, varying in size from a twenty-five to a fifty-cent piece, is made (Fig. 363). It is begun by picking up a bit of mucous membrane in the median line at the most prominent part of the cystocele, and snipping it off, the wound being enlarged by removing strips from its circumference until it is judged that a sufficient amount of redundant tissue has been removed. A stout piece of braided silk (No. 5), twelve or fifteen inches long, is threaded on a slightly curved needle (some prefer to use one at each end), which is entered just outside the lower border of the wound in the

undenuded tissue a little to one side of the median line. It is swept around the edge of the wound to the left, the tissues being kept on the stretch with a forceps or tenaculum, emerges in the undenuded tissue, is re-entered, and is thus carried around the entire wound, emerging a quarter of an inch from its point of exit—*i. e.* just above the meatus.

FIG. 363.

Stoltz's operation for cystocele.

This suture represents the string of a tobacco-pouch, traction on the ends causing the edges of the wound to pucker up and come in contact, while the raw surface is pushed inward with the tip of a sound. If the apposition is not exact after tying the silk sutures, a few superficial ones of catgut may be introduced.

The *after-treatment* is quite simple, the patient being allowed to pass her water if she can, though the bladder should not become distended. The wound is covered with aristol and the usual external dressing applied. No vaginal douches are given during the first week, and the suture is not removed for ten days or two weeks.

The ultimate results of these two operations are nearly similar. If the patient is examined five or six months afterward, a smooth linear cicatrix will be found after Sims's, and a round, somewhat puckered scar after Stolz's operation, though it must be admitted that unless the pelvic floor has been thoroughly repaired and the superincumbent weight of the prolapsed uterus has been removed, the cystocele still persists, and the cicatrix is about the only evidence that an operation has been performed.

Emmet's Method (Figs. 364, 365).—With the patient in Sims's position the uterus is anteverted, and the mucous membrane is picked up with a tenaculum a half-inch to one inch on either side of the anterior lip of the cervix, and the two tenacula are approximated to a third point in the median line in front of the cervix. A bit of mucous membrane is excised at each of the lateral points, the size of a three-cent piece, and a raw surface about twice as large is made in the median line. A needle armed with a carrying thread, in which is looped a silver wire, is passed under each denuded surface in turn from left to right. By twisting the wire the three surfaces are approximated in the median line, while a deep groove is formed in the anterior vaginal wall bordered by two prominent folds. Putting each fold on the stretch by seizing it with forceps half an inch above the level of the meatus, a strip is removed from either ridge, and the opposed longitudinal raw surfaces, which should be half an inch wide, are approximated by sutures of wires or silkworm gut which pass across the median sulcus. The amount of tissue rolled in and the degree of tension are determined beforehand when selecting the points on either side of the cervix. This operation gives excellent results, especially when done in connection with a colpo-perineorrhaphy. In cases of procidentia additional support is furnished to the uterus by making the primary lateral denudation behind the line of the posterior lip of the cervix, so that when the wire is twisted the latter will be thrown well backward and will rest on the united wounds. When there is a prominent urethrocele Emmet denudes an additional triangular surface below the two median folds, the lower angles of which diverge on either side of the urethra. A suture is passed parallel to the long axis of the vagina, approximating the base to the apex of the triangle, and thus rolling up and turning in the redudant tissue. The two diverging folds which result are then united, when a Y-shaped line will be formed.

FIG. 365.

Emmet's operation; second step.

FIG. 364.

Emmet's operation: first step.

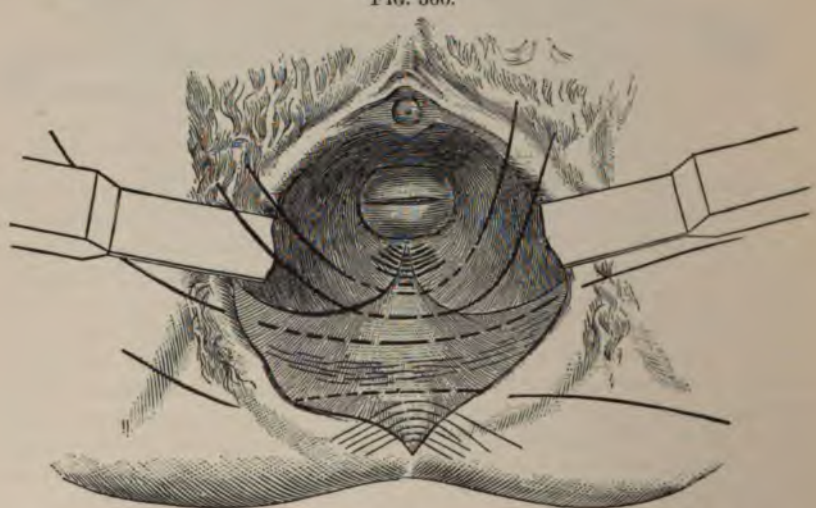
Colpo-perineorrhaphy.—It is now generally admitted that the most important vaginal lesions resulting from childbirth are not the mere tear of the perineum, but the deeper injuries to the pelvic floor, which vary in severity from a simple overstretching or relaxation of the fascia and muscles to actual tearing of the levatores ani. The object of all operations in this region is not simply to restore the external parts to their normal condition, but to repair, if possible, the deeper and invisible injuries to the pelvic floor.

Though rectocele is a usual accompaniment of this condition, there may be almost complete loss of support without this visible sign. By introducing two fingers and retracting the perineum it will be evident that some important injury has occurred, though the fourchette may be almost intact.

A number of operations have been devised for the purpose of curing rectocele. Some of these are open to the same criticism that was mentioned in connection with anterior colporrhaphy—*i. e.* they simply remove redundant tissue without providing absolute guarantee against the recurrence of the condition. The operations which will be found of most practical value are Hegar's and Emmet's. The former is easier, but probably does not meet all the indications so thoroughly as the latter.

Hegar's Operation (Fig. 366).—Select a point on the posterior vaginal wall at the crest of the rectocele; seize the tissues with bullet-forceps or pass a carrying thread beneath them. Points are then selected on

FIG. 366.



Hegar's denudation for prolapsus, front view (Hegar and Kaltenbach).

either side within the labia corresponding to the lower caruncles of the hymen. Beginning on the left side, the operator picks up the tissue with the mouse-tooth forceps and denudes a strip extending to the middle point. The two lower tenacula are now joined by a similar strip, and the triangular figure is connected by a third strip carried from the tenaculum on the right side to the middle of the rectocele. The remaining triangular strip of tissue is removed. The hemorrhage is easily controlled by pressure or hot water. The raw surfaces are brought together by silkworm-gut sutures introduced from left to right with a curved needle, beginning one-eighth of an inch below the apex of the raw surface, carried downward and slightly inward, then upward and outward, to emerge at corresponding points on the opposite side. Each suture is cut short as the other is introduced; or they may be left long and

their ends tied together. From eight to twelve may be used in all. If there has been a tear of the perineum, further denudation may be made at the lower part of the raw surface and the opposite surfaces brought together in the usual manner. This is a simple operation, may be performed rapidly, and gives fairly satisfactory and permanent results.

Emmet's Operation (Fig. 367).—The denuded surface is entirely within the vagina, and has practically the same shape as in Hegar's operation. The sutures are introduced somewhat differently. A tenaculum is hooked in the middle of the left border of the triangle, which

FIG. 367.

Emmet's operation.

is drawn upward and outward so as to form a second triangle on the left side. The sutures are now introduced in a curved direction to the number of three or four, bringing them out at the opposite edges. A similar triangle is formed on the opposite side. There now remains a small quadrilateral surface at the lower border of the wound which is brought together by two or three superficial sutures of wire, silk, or silkworm gut. Continuous catgut sutures may be used in the sulci. The advantage of this operation is that it not only removes redundant tissue, but actually contracts the vagina and restores the normal condition by bringing together the muscle and fascia at the points where separation took place. The operation is somewhat difficult to describe, and still more difficult for one to perform unless he has witnessed it several times. The subsequent results are excellent, the parts being brought together in their normal position, so that subsequent delivery may occur without a fresh tear.

The Use of Buried Sutures.—In cases of extensive rectocele where there is a large denuded surface it is impossible to bring together the edges without undue tension. In this case the buried catgut suture is useful. It is particularly applicable to Hegar's operation. The first suture is passed at the upper angle of the wound in the usual manner. Then, coming down the middle of the raw surface, the operator picks

up one-eighth of an inch of tissue on either side, introduces his needle, skips the intermediate raw surface, and re-introduces it at a corresponding point on the opposite side, and so on down to the lower angle of the wound. When this suture is tightened an inch of raw surface in the centre of the wound is brought together. A second suture is now carried from the lower to the upper portion of the wound in a similar manner, sometimes a third. Finally, the edges of the vaginal mucous membrane are brought together over the catgut with a separate row of sutures, or the same sutures may be used throughout.

The *after-treatment* in both anterior and posterior colporrhaphy is exceedingly simple. The patient is allowed to pass her urine; the bowels are moved on the third day and regularly thereafter; no vaginal douches are given during the first week. It is customary to remove the sutures from the anterior vaginal wall on the eighth day, and the external perineal sutures at the same time. The vaginal sutures are left in position for two, or even three weeks, especially if they are silkworm gut.

A word should be added regarding the technique of denudation in plastic operations on the vagina. Some gynecologists adhere to the tenaculum, but the general practitioner will find it most convenient to accustom himself to the use of the mouse-tooth forceps. Many surgeons, especially those of the German school, prefer to complete the denudation with the scalpel, removing the tissue in one piece. This not only requires considerable experience, but in the hands of the unpractised operator might lead to unsightly wounds and even buttonholes of the bladder or rectum. If the reader will accustom himself to using the forceps, with an ordinary pair of curved sharp-pointed scissors, he will find that he can control the limits of his denudation more accurately and can work more rapidly than when he uses a tenaculum. Specially devised scissors are unnecessary, though so-called right and left scissors will often be found useful, especially when working within the vaginal sulci. In order to secure long, even strips which include only the vaginal mucous membrane, one point should be observed—viz. to put each strip on the stretch before removing it, and to cut mostly with the ends of the scissors, the points being kept parallel with the strip being denuded. In this way the operator avoids (1) the wounding of the deeper tissues, which will give rise to troublesome oozing; (2) the cutting out of several irregular pieces of tissue instead of a single symmetrical strip.

Many operators still introduce the finger into the rectum either in denuding or in passing the sutures. This is unsurgical, and unnecessary unless in the immediate operation. A little practice will enable one to dispense with it. The rapid and accurate insertion of sutures in the vagina requires considerable practice even for an experienced general surgeon. The tissues are so yielding that it is no easy matter to place the sutures exactly where one wishes them. By attention to the following points this will be much facilitated: Grasp with the forceps the vaginal mucous membrane at the edge of the wound. Insert the point of the needle just beneath the raw surface, and, instead of pushing it straight across, work it under with a series of oscillations until it has almost reached the point at which it is to emerge, and then make counter-pressure at this point either with a tenaculum or forceps until

the point is engaged, when it can be easily pushed through. The writer does not believe that it is necessary to use a blunt-pointed needle in any gynecological operation, since great difficulty would be experienced in carrying it through cicatricial tissue: at the same time, the sharp needle should not be used, either one with a triangular or a hypodermic point being preferable. One caution regarding the suture, which though elementary is still useful—do not tie it too tightly. Operations which are perfect in other respects have failed through neglect of this precaution. In general, it may be added that no single operation is applicable to every case. A plastic operation must be modified according to the amount of redundant or cicatricial tissue and the location and extent of the original lesion. It may be said that the general surgeon is most apt to fail in securing the desired result in gynecological operations, not through any fault that he has committed, so much as through a failure to meet the indications in the individual case.

NEOPLASMS.—(*a*) *Benign.*—The most common are cysts, which may reach the size of a Messina orange and are found most often on the anterior wall. They rarely give rise to symptoms unless they attain a sufficient size to interfere with coitus or parturition. They are thin-walled, and lie beneath the mucous membrane of the vagina, which is movable over the cyst. They are most often mistaken for cystocele, but the diagnosis is rendered clear by introducing a sound into the bladder. If possible, the cyst should be dissected out entire and the wound sutured, with the use of a small gauze drain if the cavity is a large one and there is much oozing. Sometimes the cyst-wall is so friable, or is so intimately connected with the bladder, that it is advisable to excise a portion of it and to allow the wound to close by granulation. Schroeder has suggested suturing the edge of the cyst-wall to the mucous membrane of the vagina.

Fibromata and fibro-myomata of the vagina are rare and seldom attain a large size. They are of slow growth and do not often suppurate. If pedunculated, the pedicle may be ligated and the growth excised, or it may be severed with a galvano-cautery loop without loss of blood. Sessile tumors are enucleated, preferably with the finger or blunt scissors, since the hemorrhage is often profuse. Oozing is controlled by packing, and the edges of the wound are united with silkworm gut or chromicized catgut, with or without drainage as may be indicated. It should be remembered that the connections of these growths with the recto- or vesico-vaginal septum are often quite intimate, so that the rectum or bladder may be incautiously opened. If so, the opening is closed at once, and seldom fails to unite. In removing a small sessile tumor from the posterior fornix the writer once entered the peritoneal cavity with no untoward results.

(*b*) *Malignant.*—Sarcoma of the vagina is rare. If circumscribed, whether sessile or pedunculated, its surgical treatment is the same as that of fibroma. Being of slow growth, the prognosis as regards recurrence after an early operation, thoroughly performed, is fair. The ordinary rule to excise the healthy tissue well beyond the limits of the growth should always be observed. Diffuse sarcoma is only amenable to palliative treatment by the sharp spoon and cauterization.

Primary carcinoma of the vagina is very rare, many cases of supposed primary disease being really due to extension from carcinoma of the portio. Two varieties are recognized—papillary epithelioma, which is originally circumscribed, and diffuse medullary or scirrhous cancer. The latter may appear as a circular or diffuse infiltration of the vaginal walls, causing more or less stenosis of the canal. The disease extends rapidly, involving the rectum, bladder, and surrounding tissues, fistulous openings being established by ulceration. The inguinal and pelvic glands are involved at an early stage.

Though a radical cure cannot be expected, if the growth is circumscribed and is recognized at a sufficiently early stage it should be extirpated, even if it is necessary to remove a portion of the recto- or vesico-vaginal septum, since the fistulæ can be closed at once and union by first intention may be expected. In cases of cancer of the cervix with extension to the vagina, one-third or even one-half of the latter has been excised with the uterus, with excellent results as regards recurrence. In fact, these have been so good that surgeons have not hesitated to remove nearly the whole vagina with the cancerous rectum through the sacral incision, which affords an excellent route for exposing the parts. But in view of the certainty of recurrence it is doubtful if such heroic operations are justifiable. As a rule, all that the surgeon can do is to relieve the patient by curettage and cauterization, followed by the use of antiseptic douches, astringents, and appropriate medical treatment.

Tuberculosis of the vagina is usually observed in the form of circumscribed ulcers which result in fistulæ. They may be excised freely, and an attempt may be made to repair the fistulæ, but primary union under these circumstances is the exception.

Traumatic Lesions.—Severe tears of the vagina may occur during parturition, even when the perineum is nearly intact. These may be median, uni- or bilateral, or transverse. Extensive lateral tears are often caused by the forceps, especially during attempts to rotate the head with the instrument. These should be recognized at the time by exposing the parts under a good light and rolling out the vagina by inserting one or two fingers within the rectum. It is a surgical error to repair a lacerated perineum after labor without inspecting the vagina. The immediate repair of these lesions is easy. The patient is placed across the bed on a Kelly's pad, the anterior vaginal wall is retracted with a speculum, and a gauze tampon is pushed into the vagina to keep the field of operation free from the uterine discharge. After seizing and ligating any spouting vessels the operator hooks up the upper angle of the tear, and, using a curved needle threaded with chromicized gut, unites the edges with a continuous suture down to the lower angle of the sulcus. The direction of the line of suture will vary according as the laceration is longitudinal or transverse.

Extensive lacerations may occur during coitus, especially if there is a disproportion between the organs and the act is performed in a violent manner or in an unusual posture. Cases have been reported in which the recto- or vesico-vaginal septum was torn through, or even the posterior fornix, especially in old women with atrophy of the vagina, or in cases of atresia or stenosis. Direct violence from falls upon pointed objects, or the forcible insertion of a foreign body, is an occasional cause.

Unless promptly repaired these injuries may result fatally from hemorrhage or subsequent septic infection. They are treated according to ordinary surgical rules. Under strict aseptic precautions the parts are exposed, cleansed, bleeding points are caught, and the wound closed with catgut or silkworm gut. Fistulæ should be closed with the utmost care. If Douglas's pouch has been opened and the intestine prolapses, it is cleansed and returned, the cavity being closed or drained as may seem best under the circumstances.

Hæmatoma of the vagina generally develops during parturition, and is treated according to the rules laid down under hæmatoma of the vulva.

FOREIGN BODIES.—Various articles have been introduced into the vagina, usually by sexual perverts, though sometimes for the purpose of preventing conception. Pessaries have been forgotten and worn for years. In some instances the patients were the victims of brutal violence. The amount of injury sustained varies with the nature and size of the foreign body and the manner of its introduction. A piece of glass or a pointed object may be forced into one of the neighboring viscera, or even into the peritoneal cavity. If it has remained *in situ* for some time, it may cause ulceration, gangrene, fistulæ, and even septic peritonitis.

The **diagnosis** is often difficult, as the patient may pretend to be entirely ignorant of the cause of her symptoms. On examination the body may be so imbedded in the tissues and covered with lime salts that its true character cannot be determined. It may even have perforated the vaginal wall and become encysted in the abdominal cavity. Its removal without lacerating the vagina often requires considerable skill and ingenuity, and all sorts of instruments will be found useful, from a lithotrite to a pair of obstetric forceps. It may be necessary to incise the tissues freely, or even to perform abdominal section. It is often possible to cut or crush the foreign body. The greatest care must be exercised in the removal of sharp objects, such as bits of glass. Levis has made the ingenious suggestion to pour plaster of Paris into the vagina, in which the glass is imbedded, the whole mass being subsequently withdrawn after lubricating the vaginal mucosa freely. If a large sloughing surface is left, this is treated with antiseptic injections, and care is exercised during the healing process to prevent cicatricial stenosis. Fistulæ are to be dealt with subsequently.

In this connection reference may be made to the **treatment** of cicatrices of the vagina, which has also been touched upon in the paragraph on acquired stenosis. These may result from extensive injuries during labor that were not attended to at the time; they may be of inflammatory, cancerous, or syphilitic origin, or may be due to traumatism or the previous use of caustics. They not only give rise to pain from the inclusion of nerve-fibres, but cause hyperæmia and constitute a hindrance to childbirth. Cicatrices are common in connection with extensive vesico-vaginal fistulæ, rendering operative interference exceedingly difficult, as well as diminishing the chances of success, so that it is often necessary to eliminate this complication before attempting the repair of the fistula. In the case of moderate cicatricial contraction it is sufficient to make a few superficial linear incisions and to insert a dilator, which

is worn in the manner before mentioned. Broad cicatrices may be excised, and their edges brought together in a direction parallel with the transverse axis of the vagina. It may be necessary to relieve the tension on the edges of the wound by linear incisions in the healthy tissue. Emmet insists that the latter should always be sutured in a direction at right angles with their long axes, so as to prevent subsequent contraction. If the raw surface is extensive, flaps of healthy tissue may be turned over them. Bozeman makes a number of small cuts all over the cicatrized surface, and relies on the systematic use of dilators to overcome the tendency to contraction. He adopts this treatment previous to operating upon fistulæ, and it may be persisted in for several months before the operation is attempted.

VAGINAL FISTULÆ.

Abnormal openings in the vagina may communicate with either the alimentary or urinary tract. The former are distinguished as recto- and entero-vaginal, the latter as vesico-, urethro-, and uretero-vaginal fistulæ, these latter being further subdivided according as the opening leads directly into the vaginal canal or into the uterus. While it is customary to consider genito-urinary fistulæ under the head of diseases of the urinary tract, they belong properly under surgical affections of the vagina, since they are reached and operated upon through the latter canal.

(A) Fæcal Fistulæ.—These are distinguished, according to their location, as recto-labial, recto-vaginal, and entero- or ileo-vaginal. Rarely a communication exists between the ileum and the uterine cavity, so that fecal matter escapes into the vagina through the cervical canal (ileo-uterine). They may be single or multiple, and vary in size from a pinhole opening to one inch or more in diameter. The size of the rectal and vaginal apertures is seldom the same, being usually larger on the side on which the ulceration begins. In a traumatic fistula the communication is generally direct, but in one resulting from a dissecting abscess in the labium, or in the recto-vaginal septum, the upper opening may be two or three inches above the lower one, as in complicated anal fistula. Recto-vaginal fistulæ may be of traumatic or inflammatory origin. Prolonged pressure of the fœtal head in neglected labors is now a rare etiological factor. Incomplete union of a complete laceration of the perineum, with or without a previous operation, is the commonest cause, while sloughing due to the presence of a foreign body is less frequent. Cases have been reported in which the recto-vaginal septum has been torn during forcible attempts at coitus, especially in young subjects. Abscesses which discharge into the vagina and rectum may leave openings at any point from the vulva to the posterior fornix. Perforating ulcers of tuberculous, syphilitic, or cancerous origin have already been mentioned. Entero-vaginal fistulæ are not uncommon after hysterectomy, as well as after the removal of impacted pelvic tumors (cysts, extra-uterine pregnancy, etc.), when low-lying adherent loops of intestine have been injured. The amount of flatus and fecal matter which escapes varies with the size and location of the opening. If it is small and has a valve-like fold on the rectal side, only a small quantity of

fecal matter may escape from the vulva at intervals, especially when the bowels are loose. The diagnosis of ileo-vaginal fistula is confirmed by the escape of chyme, and if the opening is so large that all the intestinal contents pass into the vagina, the patient is in danger of dying from inanition, as in a case recently under the writer's observation. There is seldom any difficulty in locating the opening unless it is minute, when the injection of milk or aniline blue into the rectum will usually serve to identify the fistula, so that a fine probe can be passed through it. The smaller traumatic fistulæ with clean-cut edges often heal spontaneously, especially if they are well above the sphincter. The writer has succeeded in curing them by constipating the bowels with large doses of bismuth (the patient being kept on a milk diet), and maintaining constant cleanliness by repeated rectal and vaginal irrigation. The edges of the fistula are cauterized with nitrate of silver. Antisyphilitic treatment should be instituted in a suspected case, especially when there is an accompanying stricture of the rectum.

Recto-vaginal fistulæ are usually attacked from the vaginal side, the operation differing somewhat according as the fistula is situated within a half to one inch of the sphincter or higher up in the canal. One of the simplest and most surgical methods of dealing with the former is to insert one blade of a pair of straight scissors into the anus and to divide the perineal body as high as the opening, thus converting the case into one of complete laceration, which is treated according to the method previously described—*i. e.* the edges of the fistula are pared down to the rectal mucous membrane, all the cicatricial tissue being removed on either side for the distance of an inch. If there is much tension, the recto-vaginal septum can be split around the opening as far back as may be necessary to secure easy coaptation. A triangular denuded surface is thus formed. The rectal wound is now closed from the rectal side with interrupted sutures of silk or chromicized gut; the vaginal wound is repaired by sutures of silkworm gut passed in the same manner as in Hegar's operation; and, finally, the ends of the sphincter are united. The reader is advised to adopt this apparently heroic method of dealing with small fistulæ near the sphincter, since it is the only one which offers a certain prospect of success. Time is saved in the end.

Fritsch makes a semilunar incision, the convexity of which looks downward and extends to the upper edge of the fistula, and a second similar incision beginning at the ends of the first and coming down half an inch below the lower border of the opening. The included tissue is denuded, and the upper flap is drawn downward over the fistula and sutured to the lower border of the wound.

Larger fistulæ, situated an inch or more above the sphincter, may be closed directly by transverse sutures, the area of denudation being carried at least an inch outside of the edges of the opening. Where there is much cicatricial tissue it may be necessary to relax the tension by making linear incisions through the vaginal mucosa, or even to excise cicatrices and close the wounds transversely. By splitting the edges of the fistula the vaginal flaps can be more easily approximated. If it is impossible to unite the vaginal edges without too much tension, the rectal wound alone can be closed and an attempt made to fill in the vaginal wound by granulation. A triangular denudation, as in Hegar's

colpo-perineorrhaphy, often gives a good result. The best position is the lithotomy, the anterior vaginal wall being elevated by a speculum or special retractor. The same instruments, needles, and sutures are used as in the closure of vesico-vaginal fistulæ, while the preparatory and after-treatment are identical with that adopted in operations for complete laceration.

The various flap-splitting operations (Tait, Sänger) find a useful application here. In dealing with small fistulæ Lauenstein dissects up a vaginal flap containing the opening in the vaginal mucosa, closes the rectal opening with buried sutures, then turns back the flap and stitches it in his former position.

The presence of extensive cicatricial contraction of the vagina or outlet may render it necessary to close the fistula from the rectal side. After thorough preliminary cleansing of the bowels and irrigation of the rectum with Thiersch's or boric-acid solution, the patient is placed in the left lateral or genu-pectoral position, as preferred by some operators, and after dilatation of the sphincter the fistula is exposed by retracting the posterior rectal wall. The denudation is naturally much less extensive than that made on the vaginal side, and more of the vaginal than of the rectal mucosa is included in the sutures, which may be of chromicized gut or of silkworm gut, the ends of the latter being brought out through the anus.

Entero-vaginal fistulæ are usually so inaccessible, being situated high up in the vault of the vagina and surrounded by cicatricial tissue, and the working space is so limited, that it is a difficult matter to close them.

The treatment of artificial vaginal anus, and of two openings with a dividing septum, is conducted according to general surgical rules. Cœliotomy and enterorrhaphy promise the best results, and should not be delayed if the progressive emaciation of the patient indicates that her nutrition is seriously impaired. Colpo-cleisis, preceded by the establishment of an artificial recto-vaginal fistula, has been performed in intractable cases.

(B) URINARY FISTULÆ.—Vesico-vaginal fistulæ are not only the most common, but are often operated on by the general surgeon. Repair of the more complicated forms requires special training in plastic gynecological surgery—in short, few specialists have had such experience in their treatment as to warrant them in instructing others in the technique of the operation. The reader who would realize the possibilities of the surgeon's skill in this direction is referred to the writings of Dr. T. A. Emmet, to whom we are indebted for original work in this, as in many other departments of pelvic surgery. It may be stated, in general, that while uncomplicated fistulæ may be cured by a tyro in a single operation, many cases are only successful after repeated trials at the hands of experts, as Sims has pictured so graphically in his earlier writings. It is a striking indication of the progress of modern obstetrics that the frightful results of neglected labor which were so common twenty years ago are now practically unknown. Vesico-vaginal fistula is a rare condition, as shown by the statistics of the Woman's Hospital, where less than half a dozen cases are treated annually. Gynecologists of large experience have really no opportunities to become

familiar with an operation which was once so common. But it is none the less important that every surgeon should be familiar with its details. Fistulæ not infrequently follow vaginal hysterectomy, especially where the bladder-wall has become infiltrated with cancer. Symphysiotomy has been responsible for quite a number of cases. Ulceration resulting from the prolonged pressure of foreign bodies in the vagina may cause fistulæ, also the extension of cancerous disease, rupture of pelvic abscesses, etc.

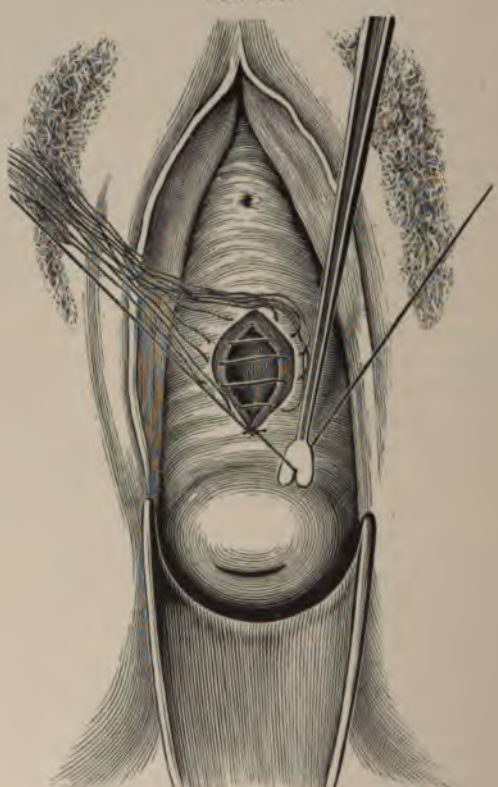
The **symptoms** of this condition and the deplorable condition to which the patient may be reduced by the constant dribbling of ammoniacal urine are sufficiently familiar. The location of the fistula when minute and buried in a mass of cicatricial tissue is not always easy to determine. The usual plan under these circumstances is to expose the parts in a good light and to inject milk into the bladder, which will be seen to emerge through the vaginal opening. The larger fistulæ are readily detected by palpation, but if the vagina has become contracted as the result of extensive cicatrization, it may be impossible to see them until the tissues have been incised and dilated sufficiently to admit a large-sized speculum.

Palliative Treatment.—Small openings may heal spontaneously, especially those following hysterectomy. An attempt should be made to close them by keeping the urine acid, by frequent irrigation of the bladder and vagina, and by cauterization of the edges of the fistula with a weak solution of nitrate of silver. A soft catheter should be retained for several days, being removed daily and cleansed.

Surgical Treatment.—Perfect technique is not the only guarantee of success in these cases, since much depends upon attention to the details of the preparatory and after treatment. It may be necessary to keep a patient under observation for two months or more before she can be regarded as ready for the operation. The urine must be repeatedly examined in order to exclude disease of the urinary tract above the bladder, the latter organ being frequently irrigated and the urine rendered acid by appropriate medication, especially by the administration of the benzoates. Phosphatic deposits along the edges of the fistula are removed and granulations touched with nitrate of silver. The urethra often becomes contracted from long disuse or the presence of cicatrices, and must be dilated up to its normal calibre. The stenosed vagina should be dilated, and cicatricial bands incised and prevented from reforming. The general condition of the patient has much to do with the healing process, so that due attention should be paid to this point. Sims's method, or a modification of it, is the one commonly adopted in this country. The patient being in the lateral position and the perineum retracted with a duck-bill speculum, beginning at the lower angle of the fistula the operator, with sharp-pointed scissors curved on the flat, removes a small strip of tissue around its edge, including all the tissue down to the vesical mucosa. Care must be taken not to excise any of the latter. Other strips are removed to the distance of from one-fourth to one-half an inch from the border of the opening, and the denudation is continued above and below to a distance of nearly an inch from the upper and lower borders, so that a large elliptical raw surface is formed, the object being not only to prevent puckering of the vaginal mucous

membrane in the neighborhood of the opening, but to reinforce the sutures which actually include its edges by the four or six others which are passed above and below it. The oozing may be quite free, but is easily controlled by hot-water irrigation or sponge-pressure. Short, slightly curved needles with blunt or hypodermic points are used. The suture material may be silk, silkworm gut, or No. 28 silver wire, the latter being best for the closure of large fistulæ, especially where there is considerable tension on their edges. It is desirable to make the line of union conform to the long axis of the vagina, but the shape and position of the fistula may be such that it is necessary to close it transversely. Two or three sutures are first inserted beneath the denuded surface which has been made above the

FIG. 368.



Tying the sutures.

upper angle of the fistula. When the latter is reached the edge of the vaginal wound is fixed with a tenaculum or tissue-forceps; the point of the needle is entered at a point one-fourth of an inch from the edge, and is passed in a curved direction downward and inward, emerging just at the edge of the vesical mucosa, but not including it. It is re-entered at the edge of the latter, and emerges at a corresponding point in the undenuded vaginal mucous membrane. The suture serves

to steady the wound while the others are inserted; they should be about a quarter of an inch apart. Finally, additional sutures are passed beneath the raw vaginal surface below the fistula. The bladder is irrigated with boiled water or boric-acid solution, and the sutures are twisted or tied, care being exercised to secure exact coaptation of the opposite edges, but no more. A few superficial sutures of fine silk may be needed, after which a gauze tampon is placed over the wound. A self-retaining catheter of block tin was formerly used, the patient being kept on her back for several hours. Some gynecologists still use a permanent glass or soft-rubber catheter until after the sutures are removed, and also constipate the bowels for several days. The consensus of opinion is now in favor of withholding opium and catheterizing the patient every four or five hours for the first two days, after which she is allowed to pass her urine. The bowels are moved on the third day as usual, the stitches are removed on the eighth or tenth, and the patient is allowed to sit up during the third week. Bozeman's ingenious and (in his hands) most successful method has seldom been practised by others, because it requires somewhat elaborate apparatus and instruments, as well as a special training in their use. After subjecting the patient to a course of preparatory treatment—incision of cicatrices and dilatation of the vagina—she is placed in the knee-elbow position on an operating-table devised for the purpose: the fistula is exposed through a trivalve speculum and its edges are denuded with a knife. Silver wires are used, but, instead of being twisted, their ends are passed through holes in a lead plate which rests directly upon the wound, and are secured with split shot and cut short. They are removed at the end of the week, a catheter being kept in the bladder in the mean time.

Simon's Method.—This is the favorite one abroad. The patient is placed in the elevated dorsal position, the vaginal walls being held apart with four large retractors, while the cervix uteri is drawn forcibly downward with a volsella. The denudation is made with a knife and includes the vesical mucosa. Alternate deep and superficial silk sutures are introduced very close together, sometimes through the vesical mucous membrane. The patient is catheterized or may pass her urine from the outset, and no restrictions are laid down with regard to position, diet, or evacuations of the bowels. The sutures are removed on the fifth, never later than the seventh day, and the patient is permitted to leave her bed a week after the operation. In spite of the radical differences between the American and German operations, it must be admitted that the results of the latter are almost, if not quite, as good, though we cannot recommend its general adoption.

Tait advocates the following flap-splitting operation, which can be performed rapidly and gives good results in uncomplicated cases. The cicatricial tissue around the edge of the opening, marking the junction between the vesical and vaginal mucosæ, is split with a knife or scissors to the distance of an eighth to a quarter of an inch. A wire suture is then passed by means of a handled needle entirely around the fistula in the raw tissue between the two flaps. When this is tightened the vaginal flap is rolled into the vagina and the vesical into the bladder, the intermediate raw surfaces being brought into close contact. In the case of larger fistulæ transverse sutures are passed between the two flaps.

General Comments.—It should be borne in mind that the desideratum in fistula operations is to obtain exact coaptation of the edges of the wound without undue tension. Unless the vaginal flaps can be pulled together easily there is much probability that failure will result, especially if the delicate tissues are strangulated by the introduction of too many sutures in the attempt to make the wound "look well." Even where there are no visible cicatricial bands, it may be advisable to split the septum around the edge of the fistula, or to make linear incisions through the adjacent vaginal mucous membrane in order to relieve tension. The condition of the bladder and urethra must be carefully studied. To close a fistula while there is an existing cystitis is to invite failure, if not to incur the danger of an extension of the inflammation to the upper urinary tract. If, as frequently happens, the bladder has become contracted, great care is necessary not to allow it to become distended after the operation. Under these circumstances the use of a permanent catheter for several days is advisable. The instrument requires constant attention in order to avoid cystitis. Contraction of the urethra must be overcome before the fistula is closed. If this contraction exists in the lower half of the canal, it may be advisable to establish a urethro-vaginal fistula before closing the opening in the bladder. Some judgment is necessary as to the proper time for removing the sutures. This is generally the eighth day, but if a slight leakage is detected on injecting fluid into the bladder, it is better to leave them for a day or two longer, inserting a permanent catheter. A small defect in the line of union will usually heal under applications of nitrate of silver. Hemorrhage during the operation is sometimes quite free, especially if the vesical mucosa is excised. It can nearly always be arrested by irrigation with hot water or boric-acid solution, or with a solution of vinegar. Rarely it may be necessary to pass a deep suture around a bleeding vessel. Secondary hemorrhage into the bladder sometimes occurs, the organ becoming distended with clots, to the jeopardy of the line of union. These must be softened by hot-water injections and thoroughly removed. The writer knew of a case in which secondary hemorrhage was so persistent that the patient became almost exsanguinated; it was necessary to remove the stitches and to tie a spouting vessel.

Varieties of Fistulæ.—*Urethro-vaginal* fistula, as its name implies, is an artificial opening in the urethro-vaginal septum, usually at some point in the upper two-thirds of the canal. Fistulæ in the lower third are generally made by the surgeon. (See buttonhole operation.) A simple fistula is closed in the same manner as a vesico-vaginal, with a few variations in certain points of the technique. The urethral mucosa being much thinner and more delicate than that of the bladder, a large-sized sound is kept *in situ* during the operation in order to press it forward into view and to prevent the movable tissues from slipping out of position. The septum being formed largely of vaginal tissue, the denudation is broader and less funnel-shaped than in the former case. Tension can be relieved by making parallel linear incisions in the healthy vaginal tissue. Atresia of the urethra must, of course, be overcome before attempting to close the fistula.

Uretero-vaginal Fistulæ.—These are rare except as the result of traumatism—childbirth, operations on vesico-vaginal fistulæ at the base of

the bladder, and following vaginal hysterectomy. Ureteric fistulæ after hysterectomy are extremely difficult to locate, and are recognized as such by the fact that the urine escapes in drops, and that milk injected into the bladder does not come through the opening as in a case of vesico-vaginal fistula, also by the use of the ureteral catheter. The most favorite site for operation is where the opening is in the anterior vaginal wall, near the cervix. It can be identified by direct probing and catheterization, an important preliminary before operating in order to determine if the duct is pervious or has been obstructed by cicatricial contraction. Bandl succeeded in closing a fistula in this locality by establishing a small opening in the bladder just below the entrance of the ureter, passing a fine catheter into the bladder, pulling the end through into the vagina, and then working it through the ureteral fistula into the ureter. An oval surface was then denuded, including both the fistulæ, and the wound was closed with wire sutures over the catheter. The flap-splitting method has also been used by Pozzi. A simple and ingenious operation performed by Bozeman consists in making a vesico-vaginal fistula just below the lower edge of the ureteral opening, and then uniting the lower border of the former to the denuded upper border of the latter.

The **treatment** of fistulous communications between the vagina and the extravesical portion of the ureter is attended with great difficulty, especially as the portion of the duct below the fistula is usually buried in cicatricial tissue so as to be impervious. This point must first be settled by practising direct catheterization of the ureter by Kelly's method. It is practically impossible to attack such a fistula from the vaginal side. In an intractable case Kelly has demonstrated the feasibility of curing the patient by opening the abdomen, dissecting out the proximal portion of the ureter, and suturing it to the bladder. Nephrectomy has been successfully performed as a last resort, especially where disease of the ureter and renal pelvis was demonstrated to exist.

Uretero-vesico-vaginal fistula is a large opening at the base of the bladder, involving one or both ureters. Under these circumstances the mouth of the ureter must be carried farther back into the bladder by splitting or dissecting it away before the vesico-vaginal fistula is closed.

Uretero-cervico-vaginal fistula is a rare lesion in which the urine escapes from the cervix as in vesico-uterine fistula, but, unlike the latter condition, a colored fluid injected into the bladder does not appear at the os externum. Catheterization of both ureters will serve to confirm the diagnosis or Bérard's test may be used—*i. e.* the amount of urine withdrawn from the bladder by a catheter in a given period should equal the amount which escapes from the vagina into a bed-pan on which the patient is kept during the time. Closure of the os is, of course, not to be thought of. An opening should be made in the bladder in front of the cervix, and the latter turned into it, as will be described subsequently.

In vesico-uterine fistula the bladder communicates with the cervical canal, the result of a laceration of the cervix which has extended through the base of the bladder. In a case in which the writer removed the uterus for rupture such a fistula developed, and was closed by a subse-

quent operation. The best method of closure is Emmet's, in which the anterior lip of the cervix is divided, and the edges of the wound held apart so as to expose the fistula, the edges of which can then be denuded and united in the usual manner.

Another method of exposing the fistula to view is by dissecting off the bladder from the cervix, as in the preliminary step of vaginal hysterectomy.

In vesico-utero-vaginal fistula the anterior lip of the cervix forms the upper border of the opening, so that in closing it it is necessary to denude both cervical and vaginal tissue. If the anterior lip has been destroyed or consists entirely of cicatricial tissue, the posterior lip is denuded and sutured to the lower edge of the fistula, thus turning the cervix into the bladder. The same procedure is adopted in extensive openings at the base of the bladder, the anterior lip being similarly denuded and united to the lower edge of the vesico-vaginal opening.

Some fistulæ are entirely inaccessible from the vagina. Under these circumstances they may sometimes be reached from above, either with or without opening the peritoneal cavity. Trendelenburg opens the bladder by a suprapubic incision (transverse), denudes the edges of the fistula, and closes it either with catgut tied from the bladder side or silk sutures which are carried through into the vagina and tied from below. A bolder method consists in opening the abdomen, dissecting off the bladder from the uterus until the fistula is reached, when it is closed with sutures carried through into the vagina, and the bladder is again sutured to the uterus in its former position.

Some vesico-vaginal fistulæ are even yet to be regarded as inaccessible on account of their size, location, and the impossibility of obtaining sufficient healthy tissue to form flaps. Under these circumstances the operation of colpo-cleisis, or closure of the vagina below the fistula, may be performed as a palliative measure. It is necessary that the portion of the urethra below the point of closure should be patent. The operation is performed in the lithotomy posture, a sound being held in the urethra. A transverse denudation is made on the anterior vaginal wall at a point just below the fistula, the effort being made to save as much of the vagina as possible, especially in young married women, and a corresponding surface is denuded on the posterior vaginal wall. The raw surfaces are coaptated by silk or wire sutures, the result in case of perfect union being the formation of a cloaca in which urine and menstrual blood collect and are discharged *per urethram*. It is manifest that scrupulous cleanliness is necessary in order to prevent decomposition of urine and the formation of calculi in the closed vagina. Simon, who originated and practised this operation in a large number of cases, was quite enthusiastic in its favor, though it does not recommend itself strongly to modern surgeons. It is certainly superior to the so-called "episiorrhaphy" of Vidal de Cassis, in which the entire vagina was closed by denuding and uniting the inner surfaces of the labia majora. It is rarely successful, since a fistula generally persists below the vestibule. Moreover, it is impossible to remove all the urine from the obliterated vagina so as to prevent decomposition.

Operations on the Urinary Tract.

Surgical affections of the female genito-urinary tract have received comparatively little attention even from specialists, in spite of the efforts of Emmet and Skene to emphasize their importance. Although the examination of the bladder and urethra in the female is so much easier than the same procedure in the male, since their interior can always be directly inspected through an artificial fistula, gynecologists have, as a rule, not taken the trouble to look for the cause of vesical symptoms, being inclined to regard them as nearly always reflex, and hence to be relieved by medicinal rather than by surgical treatment. This may have been due to the fact that the exploration of the bladder and urethra has until recently been conducted by means of specula, the use of which required special dexterity, and gave, after all, only an imperfect view of the mucous membrane. The work of Grünfeld in the field of direct endoscopy has been strangely overlooked in this country until Kelly's recent revival of endoscopy and simplification of technique and instruments gave a decided impetus to this long-neglected study by placing in the hands of the practitioner a means of inspecting the bladder under conditions which do not mask or distort the existing lesion. (For the description of Kelly's method of endoscopy the reader is referred to his writings, as well as to the recent works on gynecology.)

Operations on the Urethra.

Congenital Anomalies and Defects.—Emmet describes a rare case of congenital cleft of the urethra which he cured by first establishing an artificial vesico-vaginal fistula in order to permit the escape of urine until the new urethra was made. He then denuded a strip a quarter of an inch wide on either side of the median line, extending from the pubes to the neck of the bladder, the raw surfaces being brought into apposition with wire sutures. The result was a canal through which a small amount of urine escaped. A minute opening which persisted in the line of union was closed after two subsequent operations. The patient was discharged wearing a glass tube which served to keep the new urethra open, drainage of the bladder being maintained through the vesico-vaginal fistula. Two months later the latter had closed, when another opening appeared at the vesical end of the urethra. In repairing this the urethra was reinforced by denuding the mucous membrane over it and for a distance of half an inch on either side up to a point considerably above the fistula. This surface was turned in and secured with shotted wire sutures. A catheter was left in the bladder through which all the urine escaped. The patient was eventually discharged with fair retentive power, though the capacity of the bladder was only three and a half ounces and she was obliged to use a catheter every four hours. This case is mentioned in detail as an example of the difficulties which are encountered in this branch of plastic surgery, as well as a proof that success is only obtained by a combination of patience and dexterity which is possessed by few.

Displacements.—Skene describes a rare condition, dislocation of the entire urethra, the result of childbirth, which accompanies lesions of

the pelvic floor and resulting prolapsus uteri. It is not directly amenable to surgical treatment, but is relieved by repairing the other lesions and inserting a special form of pessary.

URETHROCELE.—The urethra may be dilated throughout its entire length, or this dilatation may be confined to the lower half of the canal. When this occurs and the posterior wall sags downward, a pouch is formed in which the urine is retained and becomes decomposed, giving rise to local inflammation, attended with various distressing symptoms—pain, frequent micturition, partial incontinence, and often a discharge of pus from the meatus. It is distinguished from cystocele by introducing a bent probe into the urethra, when it will be felt to enter a sac just inside of the meatus. It has been suggested to cure the dilatation of the urethra in the same manner as prolapse of the rectum—by linear cauterization or by the excision of V-shaped strips of mucous membrane—but the so-called "buttonhole" operation best fulfils the indications, especially in urethrocele. The object of this simple operation is not only to establish drainage, but to allow direct inspection of the interior of the urethra, the treatment of the diseased mucous membrane in chronic urethritis, the removal of foreign bodies, neoplasms, or redundant mucous membrane. Since the vesical sphincter remains intact, the patient has perfect control over her bladder, the urine being voided *per vaginam* instead of through the meatus. Skene uses a special instrument like an ordinary buttonhole scissors, but this is unnecessary.

FIG. 369.

Emmet's buttonhole operation.

The ordinary technique is as follows: The patient being in Sims's position with the perineum retracted, a block-tin sound is introduced into the urethra, and its tip is turned backward so as to cause a protrusion at a point half an inch above the meatus and exactly in the median line. With a knife or sharp-pointed scissors the surgeon cuts directly down upon the sound until the urethral mucosa appears. A small opening is made in this, and the tip of the sound is pushed through. This is held

in position in order to steady the tissues, which are so movable that without such a guide the opening in the urethral mucous membrane might easily slip out of view, and the fistula is enlarged to the desired dimensions (about half an inch in diameter) by cutting upward and downward, care being taken not to encroach on the neck of the bladder. Hemorrhage is slight. Now, picking up the urethral mucosa, the operator unites its edge to that of the vaginal opening, thus ensuring its patency. Fine silk sutures, continuous or interrupted, are used, which are removed at the end of eight or ten days. The patient is kept in bed for a week, cleanliness being secured by vaginal douches. The wound is inspected occasionally in order to remove phosphatic deposits or to cauterize exuberant granulations. The fistula is allowed to remain until the urethra has regained its normal condition, when it is easily closed in the manner already described. Emmet's operation for the cure of urethrocele accompanying cystocele has already been referred to.

In some cases the urethra seems to be torn away from its subpubic attachments during childbirth, so that it sags downward, making direct traction upon the neck of the bladder, the pressure of the contents of which is supported directly by the vesical sphincter. Want of retention or constant dribbling of urine is the result, the true cause of which is often overlooked or is not understood. It is evident that no amount of medicinal treatment, electricity, etc. will restore the parts to their normal anatomical relations. As the exact nature of the injury to the periurethral fascia is not known, attempts to repair the lesion must be more or less empirical. Since marked relief is afforded by carrying the upper portion of the urethra upward against the subpubic ligament by the introduction of a tampon or pessary (Gehrung's or Fowler's), it would seem as if a more permanent result could be obtained by shortening the prolapsed anterior vaginal wall by lifting it upward under the symphysis. The writer has succeeded in effecting a cure by denuding a parallelogram, one by two inches in dimensions, at a point opposite to the subpubic ligament, and closing it with silkworm-gut sutures passed from above downward. With the same object Skene makes a deep incision through the antero-lateral wall of the vagina on either side of the urethra, beginning at a point half an inch within the vulva and extending upward and outward for an inch or two. The edges of each wound are drawn apart, and an effort is made to insert a deep catgut suture through the deep vaginal tissues and the subpubic ligament. Three tiers of sutures are introduced. Pawlik has devised another operation, intended particularly to relieve the incontinence which sometimes follows the closure of a vesico-vaginal fistula, being due either to traction upon the neck of the bladder or to loss of power in the sphincter muscle. The object aimed at is practically the same as in the other operations—to draw the urethra upward and bring its anterior and posterior walls together. A wedge-shaped denudation is made on either side, the apices being at a point below the subpubic ligament. The same operation is applicable to cases of general dilatation of the urethra.

Prolapse of the urethral mucous membrane may occur in connection with general dilatation of the canal, or independently in consequence of relaxation of the tissues. It appears as a circular protrusion at the meatus, thus distinguished from caruncle, in which the protrusion is

confined to one portion of the opening and cannot be replaced. The two conditions may coexist. In cases of general dilatation the indication is to restore the natural tone and calibre of the urethra by cauterization or excision of redundant tissue, as before mentioned. Some authors recommend the removal of the prolapsed mucous membrane with the galvano-cautery loop, but there is considerable risk of subsequent contraction. The writer has been best satisfied with the results obtained by the performance of what might be termed a miniature Whitehead's operation—*i. e.* a circular incision is made at the junction of the urethral and vestibular mucous membranes, the redundant tissue is drawn down, two or three provisional sutures of fine silk are passed through it to prevent retraction, and the mass is excised, the edges being then united with several interrupted sutures. The catheter is used for a day or two, after which the patient may void her urine. The meatus is restored to its normal appearance without contraction.

In aggravated cases, especially where there is existing urethritis, it is advisable to establish an artificial urethro-vaginal fistula just below the neck of the bladder, to draw the relaxed mucous membrane out of the wound, attach it to the edges of the latter, and, after excising the redundant tissue, to close the opening at once, or it may be left open for a few weeks in order to make applications directly to the mucosa. Dr. Emmet advises that before the sutures are introduced a sound should be passed into the bladder in order to smooth out the urethral mucous membrane and to push it upward toward the neck of the bladder

NEOPLASMS.—The benign growths most frequently found in the urethra are papillary angiomata, or so-called caruncles. Polypi, cystic or fibromatous, are more rare. Varices are not uncommon. Condylomata may occur near or at the caruncles. These are usually single, and vary in size from a small shot to a marble. They are most often found in the lower third of the canal, especially at the meatus. Although anatomically they are mainly composed of dilated capillaries, on account of their rich nerve-supply and exquisite sensitiveness they have been described as angio-neuromata. The marked local and general symptoms to which they gave rise are graphically described in all works on gynecology.

The **diagnosis** of a urethral neoplasm is easy enough when it is situated at or just within the meatus, but when higher up in the canal it may readily be overlooked. Under the latter circumstances the frequent and painful micturition, tenesmus, pain on sitting or during coitus, occasional passage of blood, and general reflex symptoms should lead the surgeon to examine the urethra with a sound, when the extreme pain and spasm on touching a caruncle will point to the probable condition, which is discovered on inserting an endoscope or urethral speculum. Polypoid cysts and fibromata are recognized by their smooth, glistening appearance and painlessness; condylomata by their dry, whitish, cauliflower appearance and insensitiveness as compared with angiomata, which are of a light-red color, very sensitive when touched, and bleed easily. The latter are to be distinguished from varicose dilatation of the veins in the mucosa, which disappear under pressure, and when situated around the meatus from prolapse of the mucous membrane, which is replaceable. As before stated, prolapse may coexist with a polypoid tumor.

The surgical treatment of urethral neoplasms must be modified according to their size and location. Thus, small growths at the meatus may be excised and the wound touched with the cautery under local anæsthesia with cocaine or a freezing spray. But on account of the extreme sensitiveness of even the smallest caruncles general anæsthesia is usually to be advised. Large sessile external growths, especially if quite vascular, may be removed with the galvano-caustic wire, or transfixed at their bases with needles and ligated like nævi. Traction should be made with forceps while the ligatures are passed, in order that the entire mass may be removed, as this is the only sure way of preventing its return. Care must be taken to prevent undue contraction of the meatus during the healing process. For this reason the writer prefers to dissect out a caruncle involving a considerable portion of the orifice, especially if there is accompanying prolapse, and to unite the edges of the urethral and vestibular mucosæ in the manner already described.

A polypoid tumor just within the meatus is drawn down with forceps and twisted or cut off, or the pedicle may be ligated with fine silk, or divided with a snare such as is used for removing similar growths from the external ear. Indeed, aural instruments find a useful application in urethral work.

Multiple sessile growths within the canal are sometimes removed with a small sharp curette, the raw surface being touched with the cautery. A fine instrument (such as a heated needle) should be used in order to confine the cauterization to the affected area. Neoplasms in the middle third of the urethra are first located with a Skene's urethral speculum; then the lower portion of the canal is dilated with graduated sounds or Simon's hard-rubber dilators. Under a good light from a head-mirror or condenser the growth is grasped with delicate forceps and twisted off, snared, or removed with the galvano-caustic loop. The use of the latter requires a high degree of dexterity in order to avoid cauterization of the healthy mucous membrane and resulting stenosis.

A useful application of the buttonhole may be made here, as the neoplasm may be directly exposed and removed through the artificial opening, which may be closed at once or left open until the mucosa has assumed a healthy condition.

Primary malignant disease of the urethra is very rare, especially sarcoma. Cases of carcinoma confined to the meatus have been reported, but the disease usually appears as a diffuse infiltration. The disease runs a slow course, and may exist for a long time before giving rise to pain, glandular enlargement, or undermining of the general health. If external and localized, the growths may be successfully removed by free excision of the surrounding healthy tissues—even the vestibule, clitoris, and nymphæ—though the tendency to recurrence is great. Extensive operations have been performed for infiltrating carcinoma, nearly the whole of the urethra being removed, and the loss of substance repaired by an immediate or subsequent plastic operation; but the procedure is a bloody one and the amount of benefit derived is doubtful.

Traumatic Lesions.—The most common are those due to childbirth—*i. e.* dislocation of the urethra and resulting incontinence. Extreme dilatation of the canal and the extraction of calculi are responsible for superficial and deep lacerations, the latter consisting in overstretch-

ing and tearing of the fascia attached to the subpubic ligament. The unskilful use of instruments and extensive cauterization also give rise to cicatricial contraction. Traumatic stricture may result, especially at the lower third of the canal. Vesico-urethral fissure may rarely be due to direct traumatism from instruments or the passage of calculi.

Stricture of the female urethra, though not as common as some writers have claimed, undoubtedly occurs, not only as the result of traumatism, but as a sequela of gonorrhœa, as in the male. It has been noted as a congenital condition, also as a general stenosis in old cases of vesico-vaginal fistula. The chief symptom is difficult micturition, the stream being small and irregular. The point of obstruction is located by passing a good-sized sound. When the stenosis is marked chronic inflammation of the bladder, and even of the upper urinary tract, may result.

The **treatment** is practically the same as in the male. A contracted meatus is slit or dilated, and strictures higher up are gradually overcome with dilators, small linear incisions being made in obstinate cases. If the obstruction appears to be due to cicatrices in the vagina, these are divided or excised in the manner previously described. Dilatation of the contracted urethra is an important preliminary step in the treatment of long-standing vesico-vaginal fistulæ.

Vesico-urethral Fissure.—This lesion possesses an importance entirely out of proportion to its size, though it has long remained unrecognized and untreated except by specialists. It is undoubtedly more common than is generally supposed, the accompanying symptoms being erroneously attributed to inflammation of the bladder or urethra. When seen through the endoscope it appears as a small, linear ulcer, usually a quarter of an inch long, situated partly in the neck of the bladder and partly in the commencement of the urethra, which bleeds easily on being touched, and often spontaneously. The distressing symptoms, burning pain, frequent desire to urinate, and tenesmus after the act (as well as the passage of a few drops of bright-red blood) are due to the constant action of the sphincter muscle and contact with urine, which effectually prevent healing. The general health may be seriously undermined and the nervous system completely shattered by this condition, which is obviously more intractable and inaccessible to treatment than fissure of the anus.

The **diagnosis** is made by study of the symptoms, examination of the urine, the extreme pain and spasm produced by the passage of a sound through the vesical neck, and by direct inspection through the endoscope.

Local applications do little good in this affection. Instillation of cocaine solution simply relieves the pain temporarily. Strong caustics and astringents are apt to increase the trouble. Recent mild cases may be cured by introducing pencils containing iodoform and sulphate of zinc. Incision of the ulcer with a delicate knife may temporarily relieve, but does not cure. The chief indication is to paralyze the vesical sphincter, which must be done with great care in order to avoid incontinence or even laceration of the tissues. Hanks's hard-rubber uterine or Simon's urethral dilators are the best for this purpose. The procedure is a painful one, unless cocaine is used freely. In the less aggravated cases dilatation will usually effect a cure, but there still remains a source of irritation in the frequent passage of urine over the inflamed area even when it is rendered nearly neutral by appropriate

medication. It seems most rational in severe cases, and even in those which do not yield promptly to other treatment, to establish an artificial vesico-vaginal fistula in order to eliminate both the irritating action of the urine and the contraction of the sphincter. The ulcer will then heal spontaneously, or can be treated with applications or dilatation under the most favorable conditions.

Skene has described a rare condition known as incomplete internal urethral fistula, the result of an abscess within the urethra, which burrows into the urethro-vaginal septum, but does not perforate it. The surgical treatment is the same as that of urethrocele—*i. e.* the establishment of an artificial opening at the site of the fistulous track, which is closed after the tissues have been restored to a healthy condition.

Foreign Bodies.—These are calculi or objects that have been intentionally or accidentally introduced into the urethra. They give rise to pain, more or less obstruction to the flow of urine, hemorrhage, and subsequently ulceration, sometimes with sloughing and the formation of fistulæ. They are removed with forceps, loops, etc., according to their nature and position, calculi or other soft objects being previously crushed if possible, or the urethra dilated in order to permit their extraction without laceration of the tissues. Hair-pins are especially difficult to extract without injury to the mucous membrane. In some cases it may seem advisable to cut down upon the foreign body through the urethro-vaginal septum, or, if it is situated near the neck of the bladder, to push it up into that viscus and to extract it through a vesico-vaginal opening.

Operations on the Bladder.

Congenital Anomalies.—Although the operative treatment of these conditions belongs rather to general plastic surgery, they should be mentioned briefly in this connection.

Congenital fissure of the bladder, due to a defect in its anterior wall, may appear as a small opening just above the symphysis, the latter being only partially united, or the opening may exist in the neighborhood of the umbilicus. In vesico-urachal fistula the urachus remains pervious and opens externally at the navel. The entire anterior wall of the bladder may be wanting, the openings of the ureters being visible; other defects in the genito-urinary tract are usually present, such as absence of the urethra, absence or atresia of the vagina, etc. In the case of the smaller urachal fistulæ it is sometimes possible to close them by the ordinary method of denudation and suturing. In extroversion of the bladder the defect has been closed by means of flaps taken from the abdominal wall, a number of successful cases having been reported. The operation is naturally a complicated one and taxes all the resources of the surgeon.

Displacements.—The bladder may be drawn upward or laterally by adhesions, or it may be dislocated downward in the condition known as cystocele, the operative treatment of which has been described under operations on the vagina.

Neoplasms of the Bladder.—Contrary to the rule which applies in other portions of the genito-urinary tract, malignant tumors are met

with more often than benign. So-called villous tumors or papillomata may be regarded as clinically malignant, though authorities differ on this point. The early symptoms are essentially the same in the varieties of growths, so that they may be grouped together. Pain is more or less constant, situated either in the lower part of the abdomen or in the perineum, and often radiating through the pelvis. Frequent and painful micturition, obstruction to the escape of urine, especially if the growth is at the neck of the bladder, and the ordinary symptoms of cystitis are usually noted. Hæmaturia is common to both benign and malignant growths, but with the latter actual bleeding may be so profuse as to seriously affect the general health. The ureters and kidneys may be secondarily affected, either in consequence of chronic cystitis or from direct pressure of the growth on the openings of the ureter.

The **diagnosis** is sometimes rendered easy by the discharge of fragments of the neoplasm in the urine. A tumor of considerable size, especially if situated at the trigone, can be palpated bimanually. By the endoscope (and especially by the electric cystoscope) the growth can nearly always be located, and some idea of its character can be obtained, or, if possible, a small portion can be removed with a curette or cutting forceps for microscopical examination. It is, of course, possible to dilate the urethra and to introduce the finger, but, in view of the danger of lacerating the tissues or causing permanent incontinence, it is preferable, when the presence of a new growth is strongly suspected, to perform cystotomy and to palpate the interior of the bladder through the artificial opening, when the tumor can be removed at once or at a subsequent sitting. The fistula will in any case serve a useful purpose for drainage in connection with the accompanying cystitis.

The **treatment** of all vesical neoplasms is essentially surgical. Benign growths, if small and near the neck of the bladder, may be exposed through the endoscope, and either twisted off or removed with the galvano-cautery wire. If sessile and friable, they can be excised with the curette or cutting forceps, like adenoid vegetations of the naso-pharynx, hemorrhage being controlled by injections of ice-water or the bleeding surface being touched with Monsel's solution. The preparatory and after-treatment are simple, consisting in frequent irrigation with weak boric acid or Thiersch's solution.

Larger tumors are removed in the same manner through an artificial vesico-vaginal fistula, the advantages of this method being already stated. It is advisable to keep the fistula open, not only until the raw surface has healed, but until the cystitis is cured. It should be made sufficiently large to allow the growth to be pushed wholly or partially into the opening. The galvano-cautery is especially useful in this operation, since it not only allows the surgeon to effect a thorough removal of the neoplasm, but prevents the profuse hemorrhage which follows excision with a cutting instrument. Skene clamps the base of the tumor and burns it off, charring it thoroughly. In all cases the catheter must be passed every two hours for the first twenty-four hours, then every four hours.

Operations upon malignant growths are rarely followed by permanent results, except when the disease is localized and in the early stage. With extensive infiltration of the bladder-wall and marked impairment

of the general health, it is better to confine operative interference to the making of an artificial vesico-vaginal fistula and cauterization of the growth, with or without previous curettage. Portions of the bladder have been excised, and even the entire organ, the ureters being turned into the vagina (Pawlik). Epicystotomy will often be preferred by general surgeons, especially in the case of large neoplasms. (For the description of this operation the reader is referred to the article on the surgery of the bladder in the male.)

VESICAL CALCULI.—These are much less common than in the male, and are usually single and phosphatic. Moreover, they are seldom of renal origin, stones from the kidney being commonly expelled through the urethra without becoming arrested in the bladder; indeed, encysted calculi are rare in the female. The usual nucleus is a foreign body, introduced either by the patient herself or by the surgeon. A silver wire which has inadvertently been passed through the vesical mucosa and left *in situ* has frequently served as a nucleus. The writer has seen cases in which the escape of hair from a dermoid cyst, and in one instance of fecal matter from a vesico-intestinal fistula, was the etiological factor. The calculus changes its position with that of the patient, slipping down against the neck of the bladder when she is erect, and into the *bas fond* when she is recumbent. It may be encysted in the posterior wall, in the opening of a ureter, in the edges of a fistula formed between an ovarian cyst or pelvic abscess and the bladder, or in a diverticulum or cystocele.

The **symptoms** are similar to those in the male—pain and tenesmus, frequent micturition with obstruction of the flow, and hæmaturia. The writer has seen more or less constant hemorrhage produced by a soft phosphatic concretion. The symptoms may be simply those of an aggravated cystitis.

The **diagnosis** is seldom difficult even when the stone is encysted. It is sometimes detected by ordinary bimanual palpation, nearly always by sounding. Rigid asepsis should be practised in the latter procedure, the external genitals being thoroughly scrubbed and washed with bichloride solution as for an operation, and the bladder emptied and filled with boric-acid or saline solution. The sound is sterilized by boiling, the point dipped in sterilized vaseline or glycerin, and inserted under the guidance of the finger in the vagina. The distinct click felt when striking a hard stone in the male is not often noted in the female, as the soft phosphatic calculus gives an entirely different sensation. Sometimes the wall of the bladder is coated with a general phosphatic deposit, which will give a peculiar grating or scraping sensation as the tip of the sound is turned in different directions; unless the calculus is encysted, the mobility of the latter will be sufficiently distinctive.

The **prognosis**, as in the male, is modified according to the period during which cystitis has existed and the condition of the kidneys. It is usually good, as the symptoms are so marked that an early examination is made, and often cystotomy performed before the inflammation extends beyond the bladder.

Surgical Treatment.—Lithotrity is advocated for friable stones of moderate size. The operation is much easier than in the male, because of the shortness and dilatability of the urethra, and the fact that the

calculus and the blades of the instrument are under the direct guidance of the finger within the vagina. The manner of picking up and crushing the stone is the same as in the male. The fragments can nearly always be removed by simple irrigation without the use of the evacuator. The contraindications to lithotrity are so numerous that it has found little favor with gynecologists. Since it is not practised in young girls on account of the small size of the urethra, or, where the diameter of the stone is over an inch, because of the risk of tearing the urethra, and is not applicable to cases of cystocele, encysted calculus, or where a neoplasm coexists, it follows that cystotomy offers the favorite method of dealing with all calculi: the opening not only permits a thorough digital exploration of the whole interior of the bladder, but offers the best method of treating the chronic cystitis which is present in the majority of cases.

Cystotomy.—The patient being either in the left lateral or dorsal position (the latter being preferred), with the perineum retracted by a speculum, a curved sound is introduced into the bladder, and its tip is turned backward and pressed against the posterior wall of the bladder midway between the cervix uteri and the vesical neck. The surgeon cuts straight down upon the point of the sound, steadying the movable vaginal tissues with a tenaculum, so that the openings in the vaginal and vesical mucosæ shall correspond. The opening is now enlarged by cutting upward and downward with angular scissors, keeping exactly in the median line to avoid the ureters. The finger is introduced and the interior of the bladder is explored. The stone is freed with the finger or dressing-forceps (or special lithotomy-forceps), and is worked down into the opening, where it is extracted entire, or is crushed and removed piecemeal. As the lining membrane of the bladder can be directly inspected, the surgeon is able to decide whether it is sufficiently healthy to justify closing the fistula at once, or to allow it to remain open until the cystitis is cured. Under the latter circumstances the vesical and vaginal mucosæ are united by a suture of fine silk, either interrupted or continuous, which is removed at the end of a week. Hemorrhage is rarely so obstinate that it cannot be controlled by pressure or by hot or cold irrigation. In a few instances it has been necessary to pass a temporary wire suture under a spouting vessel. The fistula may be left for several months, the bladder and vagina being irrigated daily, while the urine is rendered acid by the benzoates and careful regulation of the diet. The edges of the opening must be frequently inspected and kept free from deposits, and irritation of the external genitals prevented by the use of zinc ointment. If the patient desires, she may wear a urinal. A better method is to insert into the opening a glass tube shaped like a ram's horn, which has a collar at the larger end to prevent its slipping out. The vaginal mucous membrane is sutured tightly around the tube, so that no urine can escape between it and the edge of the opening, and a small piece of rubber tubing is attached to its free end. The patient can retain her urine for four or five hours by clamping the tube, and then allow it to escape into a vessel, thus being freed from the annoyance of the constant dribbling. The bladder can be irrigated through the tube. Practically, it is open to the same objection that applies to any foreign body in the

bladder—*i. e.* lime salts become deposited upon it and form the nucleus for another stone.

It should be borne in mind that the removal of a calculus and prolonged drainage of the bladder do not prevent the subsequent formation of another stone, so that the patient should be directed to watch her urine closely and to report promptly on the reappearance of her former symptoms.

Epicystotomy may be required for the removal of an unusually large or encysted calculus. If an explorative cystotomy has previously been performed, the vaginal opening will be useful for drainage, enabling the surgeon to close the suprapubic incision at once.

Foreign Bodies.—The surgeon is called upon to remove foreign bodies from the bladder more frequently than from any other viscus. Winckel divides them into three classes, those entering the bladder from the interior of the body by perforation, those introduced through the urethra, and those which form within the bladder itself. Reference has been made to the fistulous communication between the viscus and a dermoid cyst, through which hair, teeth, and other matter may escape, forming the nuclei of calculi if not promptly removed. Hydatid cysts may rarely discharge their contents through such a route. An adherent ectopic sac or loop of intestine may ulcerate, discharging bones, fecal masses, and concretions, or even intestinal parasites, into the bladder. But more common than these are the various objects introduced through the urethra by the hysterical or sexually perverted, the list of which includes pins, needles, hair-pins, pencils and pen-holders, and catheters which have been broken or inserted entire. Under the head of bodies originating in the bladder are included calculi, which have already been considered.

The **diagnosis** in the case of foreign bodies which have been introduced through the urethra is seldom difficult, though the patient may persistently deny all knowledge of it. The acute symptoms—pain, frequent micturition and tenesmus, and hemorrhage, with the absence of the usual symptoms of cystitis—would indicate a recent lesion of the bladder and lead to a local examination. In cases of fistulous communications between the bladder and cysts, ectopic sacs, abscesses, intestines, etc. there is usually a history of previous pelvic inflammation, followed by a sudden discharge of characteristic material in the urine. Cystitis of a peculiarly virulent type rapidly develops, which, if not soon relieved, leads to fatal pyelo-nephritis. In addition to this are the characteristic symptoms of foreign bodies before mentioned.

The **treatment** is essentially that of calculus—*i. e.* prompt removal, through the urethra, if possible, if not by cystotomy. Considerable ingenuity is required in extracting sharp objects without injury to the tissues, especially if they have become imbedded in the mucous membrane. It may be necessary to cut hair-pins, pencils, etc. into two or three pieces before they can be extracted. Cystitis is treated subsequently.

In the event of a fistulous opening being discovered between the bladder and another viscus or pelvic sac, the first indication is to drain the bladder through an artificial fistula, to remove all foreign material, and thus to prevent renal complications; then, when the patient's con-

dition admits it, to open the abdomen, remove the adherent mass, and close the fistula from without. If there is a large opening in the gut, resection may be necessary.

The treatment of traumatic lesions has been discussed in connection with fistulæ. In rupture the conditions are the same as in the male, likewise the treatment. The surgical treatment of cystitis—cystotomy—has been described.

Surgery of the Ureters.

Until within the last four or five years affections of the ureters in the female were regarded as possessing a purely pathological rather than a surgical interest. We are indebted to Pawlik in Germany, and more especially to Kelly in this country, for developing an entirely new line of work in this direction.

Examination and Catheterization of the Ureters.—The normal ureter is readily palpated by sweeping the finger downward and inward over the anterior vaginal wall, when it is felt beneath the tissues as a distinct cord which can be traced from the side of the pelvis to the trigone in front of the cervix uteri. Through the rectum it can sometimes, especially if enlarged, be traced upward beneath the broad ligament to the pelvic brim. It lies to the inner side of the internal iliac artery. Enlargement and thickening of the duct can be made out, especially at the point where it dips beneath the broad ligament. It can be more clearly mapped out when a fine bougie is introduced into it through the bladder.

Pawlik catheterizes the uterus with the patient in the knee-chest position, but in this country she is placed in the lithotomy posture and the posterior wall is retracted, so as to expand the anterior vaginal wall, upon which, when the bladder is distended, will be seen two oblique folds radiating from the region of the trigone, which indicate the intravesical portion of the ducts. A delicate catheter, specially devised for the purpose, is introduced into the bladder, and its point is revolved so as to cause a slight protrusion of the vaginal wall opposite to the trigone. The tip of the instrument is moved upward and downward until it is felt to slip over a slight projection, when it is gently pushed against this until it is felt to enter the ureter without resistance. The escape of urine by drops confirms the opinion that the instrument has entered the ureteric opening.

In catheterization by Kelly's, or the direct, method the patient is placed in the dorsal position with the pelvis elevated, or in the genu-pectoral posture, and the urethra is dilated sufficiently to admit a cylindrical speculum twelve to fifteen millimetres in diameter. The interior of the bladder can now be directly inspected with the aid of a head-mirror. By turning the speculum thirty degrees to one side the ureteric opening is seen as a small depression, the mucosa being of a darker shade than elsewhere. The orifice being located with a probe, the catheter is passed directly into it. By using long, delicate elastic catheters Kelly is able to traverse the entire urethra and catheterize the renal pelvis. The immense practical value of this procedure is evident in cases of unilateral renal disease, dilatation and obstruction of the intrapelvic portion

of the ureter resulting from inflammatory exudates, injury during operations (ligation of the ureter), etc. By passing bougies into both ureters previous to the performance of hysterectomy they are positively located and avoided in tying the uterine arteries.

CONGENITAL ANOMALIES.—One ureter may be absent with the corresponding kidney—one or both ducts may be double, but with single vesical openings. One or both may enter the rectum, vagina, or urethra. In congenital absence of the bladder the openings of the ureters may be in the lower abdominal wall. The attempts to turn a deviated ureter into the bladder are few, and still fewer have been successful. In Baker's case, where the ureteric opening was near the meatus, a probe was introduced into the duct, and with this as a guide it was opened, dissected up as high as the trigone, where an opening was made into the bladder; the ureter was turned into it and sutured, the result being successful.

OBSTRUCTION OF THE URETER.—This may be due to the lodging of a calculus in some portion of the duct, to constriction in consequence of ureteritis, or to direct pressure from without by a tumor or inflammatory exudate. In addition to this should be mentioned ligation or clamping of the ureter during the performance of hysterectomy.

URETERAL CALCULI.—The surgical treatment of impacted ureteral calculus has assumed more practical interest in the case of the female, probably because the surgical anatomy of the duct has been more carefully studied, and also because it is accessible at more points than in the other sex. Remembering that the commonest sites of impaction are just below the renal pelvis and at or near the ureteric opening in the bladder, it becomes an interesting question to decide at which of these points the stone is arrested. When it is near the kidney the local pain and tenderness persist, and palpation may in a thin subject enable the examiner to determine the situation of the calculus. If the obstruction is complete, hydronephrosis will develop rapidly. But the crucial test is made by catheterizing the affected ureter, when a failure to obtain any urine (and at the same time to reach the stone) will at once establish the diagnosis. Without this the evidence is often entirely misleading, as in two cases under the writer's observation in which the symptoms of impacted calculus seemed to be positive, but on opening the renal pelvis and passing a Weir's ureteral probe down into the bladder no foreign body could be found. An impacted calculus in the intrapelvic portion of the ureter can usually be detected by vaginal and rectal palpation, the diagnosis being confirmed by catheterization. Under these circumstances it can be removed either *per urethram* through a speculum if it is at the ureteric opening, by cystotomy and extraction with forceps, and by cutting down the ureter through the vaginal fornix. If it is necessary to open the abdominal cavity, the extraperitoneal operation is preferable. Cabot has advocated this method for the removal of calculi impacted at all points in the course of the ureter. Kraske's method has also been utilized. In every case a longitudinal slit is made in the ureter, which is at once closed with fine silk sutures. Obstruction of the intrapelvic portion of the ureter by exudates, or in consequence of ureteritis, can often be overcome by gradual dilatation with fine bougies, the dilated portion above the point of obstruction being systematically drained and irrigated with

an antiseptic solution. If the obstruction is due to a tumor impacted within the pelvic cavity, the removal of the latter is, of course, indicated.

URETERITIS, a condition which is now recognized clinically by gynecologists by the localized pain, frequent micturition, the presence of pus without mucus in an acid urine, and by the enlargement detected on palpation, is amenable to direct treatment by catheterization and irrigation of the affected duct. Kelly's method of direct catheterization is now preferred to Bozeman's, in which the ureteric opening is exposed by establishing a large opening at the base of the bladder.

TRAUMATIC LESIONS.—Skene has called attention to the fact that the ureters are injured during childbirth much more frequently than was formerly supposed. An acute ureteritis may result, or the inflammation may assume a low, subacute form, which is treated as above mentioned.

Injuries during operations are most common. The ureter may be ligated, clamped, or divided. Even temporary compression with forceps may cause adhesion of the walls of the ureter and complete obstruction, as in a fatal case of abdominal hysterectomy reported by the writer; or through a slight injury to its wall or the extension of an adjacent ulcerative process a uretero-vaginal fistula may develop several days after the operation. Formerly the only method of dealing with accidental excision of a portion of the ureter was extirpation of the kidney—a heroic procedure which is especially formidable if undertaken in the case of a patient already suffering from the effects of a prolonged operation. Thanks to the work of Van Hook and Kelly, the number of cases in which nephrectomy will seem to be necessary will in the future be few. Immediate repair of injuries during the removal of impacted ovarian and uterine neoplasms is indicated when the lesion is recognized at the time. Longitudinal wounds are sutured and covered with peritoneal flaps; transverse ones by introducing the sutures in such a way as to render the line of union vertical, thus avoiding undue contraction. When the ureter has been completely divided lateral implantation is indicated. This consists in ligating the proximal end of the ureter, making a longitudinal slit below the ligature and inserting the distal end into it. Two rows of fine silk sutures, deep and superficial, are used. Van Hook claims that this operation can be performed even if an inch of the ureter has been excised. When it is impossible to thus approximate the ends the proximal should be ligated, and the distal end sutured to the most accessible point in the base of the bladder, or brought up and secured near the lower angle of the abdominal wound. The rectum should never be selected as an artificial outlet for the escape of urine.

Secondary operations for obstruction of the intrapelvic portion of the ureter in consequence of a previous injury or ligation are more difficult than the primary, because it is usually necessary to dissect out the ends of the duct from a mass of cicatricial tissue; cœliotomy with the patient in Trendelenburg's posture is the best method. The point of obstruction is previously located by passing into the ureter a bougie, which may be left *in situ* as a guide.

Operations on the Uterus.

Under this head are here included all operations upon the uterus which can be performed through the vagina, with the exception of total extirpation; also operations for the cure of displacements which do not involve abdominal section. They may be divided into operations for the relief of congenital malformations, for the removal of neoplasms, for displacements, traumatic lesions, and inflammatory conditions.

The CONGENITAL ANOMALIES which require surgical treatment are atresia, stenosis, and anteflexion; the two latter may also be acquired.

Atresia.—This condition generally accompanies vaginal atresia, but may exist in the uterus alone. The site of the os may be indicated by a small depression in the mucous membrane, or no trace of it may be found. The portio may be entirely absent or imperfectly developed. The uterus may be bicornate, with closure of one horn.

The **symptoms** have already been mentioned—*i. e.* recurrent menstrual pains without flow, and the gradual development of a median tumor, which is to be distinguished from fibroid and pregnancy. Hæmatosalpinx usually results, and may lead to a fatal termination by rupture. In a double uterus spontaneous rupture may take place into the open horn, or, if it is adherent to the intestine or abdominal wall, perforation may occur, with subsequent septic infection.

Simple atresia is overcome by introducing a trocar or aspirating needle at a point corresponding to the position of the os externum, and pushing it carefully upward in the axis of the uterus until the retained blood begins to escape, when a narrow-bladed bistoury or closed scissors is introduced at the side of the trocar and the opening is enlarged. Further dilatation is effected first with a pair of uterine dressing-forceps, then with an Ellinger's or Sims's dilator. After gradual evacuation of the retained fluid the cavity is irrigated with bichloride (1:8000), followed by boiled water, and a hard-rubber drain is inserted. It is not advisable to tampon the uterine cavity with gauze, as violent contractions may be set up, with the possible danger of rupturing a distended tube. The latter, if accessible, may be punctured and incised *per vaginam*, or removed by abdominal section if it does not diminish in size. Strict aseptic precautions should be observed during the operation, and intra-uterine irrigation practised subsequently in order to avoid septic infection. Occasional dilatation of the os is necessary, and the use of a stem or gauze drain in order to prevent contraction. In atresia of one side of a double uterus the pervious cervix may be dilated and the hæmatometra punctured through the septum, the opening being dilated, or, better, a portion of the septum being excised in order to establish a permanent connection between the two cavities. In some cases the sac can be punctured through the vaginal fornix. Cœliotomy and removal of the atretic horn or of the entire uterus has been intentionally performed with success, but more often the condition is not recognized until the abdomen is opened or even after the tumor has been removed, it being mistaken for a fibro-cyst, an intraligamentous ovarian tumor, or ectopic gestation.

So-called acquired atresia is usually limited to the os externum,

though it may involve the entire cervical canal. It is usually due to traumatism (the unwise use of caustics or operations on the cervix in which care has not been taken to preserve the patency of the canal), but may result from previous inflammation in childhood complicating one of the infectious diseases, when, if not complete, it may escape recognition until attention is called to it during labor; or cervical endometritis may lead to adhesion of the opposed mucous surfaces. It is not very rare in old women, in whom senile endometritis, aided by the normal atrophy of the tissues, is the usual etiological factor. Cancer of the cervix rarely leads to complete occlusion of the os. Hæmatometra from acquired atresia is more common, the curious condition known as physometra being secondary to decomposition of the retained fluid.

The **treatment** is the same as that of congenital atresia, with the addition that, since in the acquired form there is cicatricial tissue which has a great tendency to contract, this must be provided against by making bilateral or multiple incisions through the portio if necessary, and thoroughly divulsing. It is always desirable to see the patient at intervals for several months, in order that the patency of the canal may be maintained by passing a large-sized sound.

Stenosis.—By stenosis of the cervical canal we understand any contraction of its ordinary calibre. It may vary from a slight diminution in the normal to almost complete atresia, the cervix being so small that it will not admit the finest probe. The condition is often congenital, and under those circumstances is frequently associated with anteflexion. Stenosis usually occurs at the os internum—the so-called "pinhole os"—the other portion of the canal being often actually dilated. The acquired form may result from the lesions of parturition, from ulceration following diphtheria, scarlet fever, and other diseases in early life, and is sometimes found in senile uteri. Cauterization with strong acids and nitrate of silver, which were formerly much resorted to, was a frequent cause of this condition.

Dilatation of the Cervical Canal.—The indications for this operation are primarily to overcome stenosis, but more often as a preliminary step to all manipulations within the uterine cavity, from topical applications to the removal of intra-uterine neoplasms. Dilatation may be gradual or rapid (divulsion), and may be bloodless or performed with cutting instruments. Gradual dilatation for the purpose of overcoming stenosis of the os internum is resorted to in clinics and office practice in the case of patients who refuse anæsthesia. Although a simple procedure, due aseptic precautions should be observed, as in every case in which an instrument is introduced into the uterine cavity.

The anterior lip of the cervix being steadied with bullet-forceps, the os externum is stretched with a Sims's dilator if necessary, and a small-sized sound (the upper three inches of which have been dipped in pure carbolic acid and then in boiled water) is passed, followed by a steel or hard-rubber dilator (Peaslee's or Hank's), which is introduced through the os internum and allowed to remain for a few minutes. The spasmodic contraction of the sphincter muscle is overcome by gentle pressure, the handle of the instrument being carried well backward, so that the tip will follow the direction of the uterine canal. As soon as it is withdrawn the next size is introduced. By this gradual method a little gain

is made each time, the séance lasting ten or fifteen minutes, and being terminated as soon as the patient complains of considerable pain and the limit of dilatation is reached. The dilatation may be repeated two or three times a week, especially during the week preceding menstruation, in a patient suffering from so-called obstructive or spasmodic dysmenorrhœa with sterility. No bad results follow the manipulations, provided that aseptic precautions are observed, that violence is avoided, and that the presence of any subacute inflammatory conditions of the adnexa has been carefully excluded.

This operation is necessarily an imperfect one, since the muscle is merely temporarily stretched and tends to resume its former condition, so that even after a full-sized instrument can be easily passed it is advisable to see the patient once or twice a month, especially just before her period, in order to be sure that the stenosis has not returned. The occurrence of pregnancy is, of course, the best test of the success of the operation, as well as the means of effecting a permanent cure, though this can seldom be expected, as the endometrium is generally diseased in these cases, so that curettage is indicated.

Reference should be made to gradual dilatation with tents as an aid to intra-uterine examinations and the removal of neoplasms. Tents have been too generally rejected, since they have a distinct field of usefulness, accomplishing what instruments do not—*i. e.* general softening and relaxation of the tissues, as well as overcoming the resistance of the internal sphincter. In the case of a long, rigid cervix they are especially useful.

Rapid dilatation may be accomplished under anæsthesia by the graduated sounds already referred to, or these may be used to overcome the existing stenosis sufficiently to admit the passage of a branched instrument.

The technique of divulsion with the branched dilator is as follows: The patient being in the dorsal posture upon a Kelly's pad, with her external genitals and vagina thoroughly prepared as for a radical operation, the posterior vaginal wall is retracted by means of a Sims's or self-retaining speculum, and the anterior lip of the cervix is seized with a volsella, sufficient traction being maintained to keep the uterus steady without drawing it downward. The direction of the canal having been previously determined, a small-sized instrument (Sims's or Ellinger's) is held lightly between the thumb and finger and slipped through the os internum, no force being used. The handles are then compressed, and are carried well backward against the speculum. Having continued the dilatation from three to five minutes, the tip of the instrument is turned alternately to one side and the other, and finally backward, so as to dilate the entire cervical ring. The object being to overstretch or paralyze the sphincter muscle, it will usually be necessary in the case of a rigid nulliparous cervix to use a second more powerful instrument provided with a screw (Goodell's or Wathen's), which maintains the blades in position when expanded, thus relieving the grip of the hand. If the screw is used to separate the blades, it should be turned slowly so as to gradually overcome the resistance. While a dilatation of from one-fourth to one-half inch is generally sufficient, it may be carried up to an inch under favorable conditions. The

risks of this operation when performed intelligently and under aseptic precautions are practically *nil*. In dilating a cervix which is the seat of cicatricial contraction care must be used not to exercise undue force, since the tissue sometimes gives way and an extensive tear results, which may extend up to the base of the broad ligament. This has happened to the writer on several occasions, though without any ill results.

Dilatation with Cutting Instruments.—The cervix may be divided on both sides, or through either the anterior or posterior lip, with scissors or knives especially devised for the purpose. It is sometimes necessary to perform this operation as a preliminary step in the removal of uterine tumors. Division of the external os is a very simple operation which does not need to be described. Lateral, or sometimes crucial, incisions are made. Division of the entire infravaginal portion of the cervix is indicated, especially in cases of extreme anteflexion with stenosis. The cervix is steadied with a tenaculum, being drawn down as far as possible in order to straighten out the angle of flexion. One blade of a pair of angular scissors is passed into the canal, and the entire posterior lip of the cervix is divided up to the vaginal roof with a single cut. A steel dilator may be passed in order to complete the dilatation up to the os internum. There may be considerable hemorrhage, but it is easily controlled by a tampon. In antero-posterior division, or Sims's operation, after incising the posterior lip, a Sims metrotome, set at an angle with the handle, is passed into the cervical canal through the os internum. With a slight cutting motion the posterior portion of the cervix is then divided for about one-eighth of an inch. The knife is then withdrawn, the blade turned anteriorly, and passed through the canal, and is again drawn out so as to make a cut of the same depth. The branched dilator is now introduced and the dilatation completed. The entire operation may be performed with the knife alone. In the preaseptic days this operation, slight as it appears, was fraught with considerable danger, cases of profuse hemorrhage and fatal peritonitis or cellulitis having been reported. The circular artery has been divided, giving rise to such hemorrhage as to require suture. After incision, or posterior section, as the operation is called, the patency of the canal is secured by the introduction of a glass plug.

The writer would hardly recommend this operation to the general practitioner, since its proper performance requires a considerable amount of skill and an acquaintance with the anatomy of the parts. One is apt to err, either by making the incision so slight that the obstruction is not overcome or by cutting too deeply. There are few cases of stenosis so extreme that they cannot be overcome without resort to a bloody operation.

Curettage.—This little operation is probably performed more frequently than any other in minor gynecological surgery, and is, on the whole, one of the most satisfactory as regards immediate results, although it must be acknowledged that it is sometimes necessary to repeat it at longer or shorter intervals. Its simplicity and the rare occurrence of any serious complication sometimes lead the general practitioner to infer that no special aseptic precautions are necessary in performing it. On the contrary, not only does the thorough use of the curette require considerable care and experience, but under certain conditions it may be a

dangerous instrument in the hands of a careless and unskilled operator. Curettage may now be regarded as the usual preliminary step before all operations upon the uterus the object of which is to restore the endometrium to a healthy condition and to reduce the size of the organ. The indications for its use are sufficiently clear—to remove from the interior of the uterus either loose foreign bodies, such as blood-clots, retained products of conception, etc., or to scrape away the diseased endometrium and diffuse neoplasms, which not only involve the lining membrane, but extend into the subjacent muscular tissue. A sharp distinction was formerly made between the indications for the use of the dull wire curette and the cutting instrument. The former, as is well known, is a loop of copper wire which bends easily, and could only do injury to the uterine wall in cases in which the latter was abnormally thin or soft, or where an unusual amount of force was employed. Its use is now practically limited to purposes of diagnosis, since it has been recognized that it is impossible to thoroughly remove diseased tissue with the dull instrument. Even in the familiar cases of so-called hyperplastic endometritis or uterine fungosity the sharp instrument is preferred, since the object aimed at is to remove the entire endometrium, and not simply the villous projections known as "granulations." Between the sharp curette of Sims and the dull wire instrument a choice may be made of curettes with less sharp edges, such as Hanks's or Recamier's, which accomplish the desired purpose equally well with less risk.

The technique of the operation, though simple, should be carried out in all its details if success is desired. A few operators still prefer to place the patient in Sims's position. The dorsal posture seems preferable for several reasons. When it is desirable to perform another operation subsequently, it is not necessary to change the patient's position; the cervix can be exposed equally well with the patient on the back, the uterus can be steadied by one hand on the abdomen, and subsequent irrigation of the uterine cavity and the introduction of gauze can be accomplished more easily in the dorsal posture. The patient being upon her back and the limbs supported by a leg-holder, with a Kelly's pad placed beneath the buttocks, the external genitals and vagina are thoroughly disinfected as for a radical operation. The perineum is retracted with Sims's or a self-retaining speculum, such as Auvard's or Edebohl's. The cervix is exposed, the anterior lip is grasped with a volsella and steadied, but not drawn downward. The cervix is then dilated, first with Sims's and then with Goodell's or Wathen's two-branched instrument. A curette of proper size is then selected, is given a curve corresponding with the axis of the uterus, and is introduced gently between the thumb and finger and passed up to the fundus. It is then drawn up and down from the fundus to the os internum with a gentle scraping motion. The anterior, posterior, and lateral walls are curetted in turn, and special attention is paid to the cornua, where uterine fungosities are most apt to be found. The motion is entirely a vertical one, rotation of the handle of the instrument being inadvisable. At intervals it is withdrawn in order to remove a portion of the detached tissue. There is no fixed rule as to the time to be devoted to curettage in a given case. This is largely a matter of experience, and depends upon the size of the uterine cavity and the amount of material to be removed. It is advis-

able to continue the scraping until every portion of the uterine wall gives a hard, grating sensation, which shows that the submucous muscular layer has been reached. After the first dilatation of the os the uterine cavity is thoroughly irrigated with boiled water or a weak antiseptic solution. The writer prefers for this purpose a small glass tube, the os having been sufficiently dilated to permit a free return flow. This instrument is much cleaner than the double-current catheters commonly in use. After irrigation curettage should be repeated, and continued as long as any tissue can be removed. The application of astringents to the raw surface is a matter of choice. It has been demonstrated anatomically that the destruction of the diseased tissue is more thorough, and the regeneration of the endometrium more complete, after applications of liquor ferri subsulphatis than when none is used. It is customary to introduce a strip of gauze into the uterine cavity after curettage for the purpose of drainage, though why this should be necessary in aseptic operations is not clear.

The operation, as thus described, is the one practised in ordinary cases of hyperplastic endometritis. Curettage of the pregnant uterus after abortion or delivery at full term requires more care because of the softening and thinning of the uterine wall. The dull wire curette is particularly applicable to this class of cases. A sharp instrument, if employed, is to be used very carefully. Subsequent tamponade of the cavity is a more rational procedure in such cases, especially if the retained product of conception has become infected, since the gauze not only favors drainage, but promotes contraction of the relaxed organ. The use of the sharp curette or spoon within the uterine cavity for the removal of malignant neoplasms is now seldom resorted to except for diagnostic purposes and to relieve hemorrhage, since the fact has been clearly recognized that such interference often hastens the spread of the disease, and is attended with considerable danger of perforation of the uterine wall. When it is impossible to perform a radical operation it is doubtful if much benefit is derived from curettage of the interior of the uterus, with or without subsequent cauterization.

The dangers of the operation are the introduction of sepsis, perforation, and the lighting up of a latent pelvic inflammation. The former may be perfectly eliminated. A few cases of perforation have been recorded, most of which were due either to undue violence or to pathological softening of the uterine wall. In an aseptic case no bad result should follow. In a case of septic endometritis an immediate resort to abdominal section may be necessary. It was formerly held that the operation was absolutely contraindicated in all cases of disease of the ovaries and tubes, fixation of the uterus, or parametric inflammation, but if care is exercised not to make undue traction on the uterus and absolute asepsis is observed, such cases may be handled with impunity; in fact, the operation was formerly recommended for the purpose of favoring the escape of the contents of a diseased tube into the uterine cavity—a result, however, which has been questioned by competent observers.

Imperfect Invagination of the Cervix.—Under this term Skene describes a congenital anomaly in which the anterior vaginal wall is attached to the cervix at a much lower level than the posterior, with the result that the cervix is bent forward so as to lie in the long

axis of the vagina. He corrects this malposition by a simple operation. With the patient in Sims's position the posterior lip of the cervix is drawn backward with a volsella, so as to put the anterior vaginal wall on the stretch at the point where it is reflected on to the cervix. A transverse incision an inch long is made three-fourths of an inch in front of the os, varying in depth from a quarter- to a half-inch, and the vaginal mucous membrane is dissected up for a little distance from the edge of the wound, as in ordinary flap-splitting operations. When a tenaculum is inserted in the middle of either edge of the wound and the two are drawn apart, a diamond-shaped raw surface is formed, which is closed transversely with three or four silk or silkworm-gut sutures. It is evident that by thus lengthening the anterior vaginal wall and relieving the traction on the anterior lip of the cervix, the latter is thrown backward, so that the os points nearly in its normal direction.

Neoplasms.

Benign Growths.—These are recognized clinically as pedunculated and sessile, and are with rare exceptions fibromata containing more or less myomatous or myxomatous tissue. So-called mucous polyps are small glandular or fibro-myxomatous growths seldom exceeding a marble in size. The pedicle may be attached at any point in the cervical canal or above the os internum, and the growth may present at the os externum or protrude from it. If small, they either give rise to no symptoms, or to only a moderate leucorrhœa. The larger polypi not infrequently cause menorrhagia, obstruction to the menstrual flow, sterility, and ill-defined aches and pains.

The **treatment** is simple. Since the cervical canal is already dilated by the growth, the latter is readily accessible, though occasionally it may be necessary to stretch or incise the os externum in order to remove it. Strict asepsis is necessary, as serious consequences have followed even these trivial operations when conducted in the office, or with unclean instruments. General anæsthesia is not required. The polypus is grasped with a volsella, is drawn well downward, and twisted several times around the pedicle, which will nearly always give way close to its base. If the pedicle is somewhat thick, it is divided with scissors after making torsion, the base being touched with the cautery if there is a tendency to hemorrhage, which, however, can always be controlled with packing. The ecraseur and galvano-cautery are also used. Pedunculated fibroids may spring from any portion of the uterine cavity, and vary in size from a pea to the fœtal head at term. They may be confined to the uterine cavity, may appear at the os externum, or completely fill the vagina, presenting at the vaginal outlet. They sometimes give rise to prolapsus and even to inversion. They may be single or multiple, and are often associated with interstitial and subperitoneal tumors. It is important to bear in mind a few anatomical facts in connection with fibroid polypi, especially the prominent symptom—hemorrhage. The latter is due not to the presence of the tumor so much as to the accompanying endometritis; hence the menorrhagia does not correspond in degree with the size of the tumor. Moreover, the bleeding attributed to large interstitial or subperitoneal growths is frequently found after removal of the mass to

have been due to a small intra-uterine polypus, the presence of which had been unsuspected. This also furnishes an explanation of the failure of many palliative operations (electrolysis, curettage, ligation of the uterine arteries, or even castration) to relieve this symptom. The recognition of a small intra-uterine polypus is not easy when the uterus is only moderately enlarged and the cervix is long and undilated. Its presence may be suspected, but the diagnosis is not certain until the uterine cavity has actually been palpated with the finger, which takes the precedence over all other instruments in this exploration. A soft polypus gives no distinct sensation when the sound is introduced, and, while the sharp curette may bring away small mucous polypi and bits of hypertrophied mucosa, it may glide over a larger growth without detecting it. In spite of the preference given by recent writers for divulsion with steel instruments, any one who has had much experience with them must admit that for thorough dilatation of the os internum, and softening and relaxation of the tissues, tents are still unsurpassed, and, if proper precautions are observed, are as safe as other instruments. Rules for their introduction will be found in works on gynecology. Theoretically, their insertion is an easy matter, but practically they seldom accomplish what is desired, because they slip out of the os internum and only dilate the cervical canal. When one hears of cases in which the uterine wall has been perforated, or sepsis introduced, by a tent, he can only infer that the accident probably happened to a man in whose hand any instrument would have been equally dangerous.

Intra-uterine polypi are handled somewhat differently according to their location and the size of the pedicle. If the latter is slender, it can often be severed by simple torsion, assisted by the scissors or Thomas's spoon-saw. The latter instrument has fallen into disrepute by reason of cases of perforation of the uterine wall that have been reported. In all of these it was used to enucleate sessile tumors—a dangerous procedure at the best—but when applied to its legitimate use—severing the pedicle of a growth that cannot be reached in any other way—it is a safe and valuable instrument. While strong traction and torsion are made the spoon is pressed closely against the pedicle at the point where it springs from the tumor, and a gentle rotary motion is used until the pedicle is felt to give way. By keeping close to the tumor the danger of injuring the uterine wall is reduced to a minimum, even when the pedicle is quite short. If the latter can be encircled with the galvano-caustic wire, it can be divided more smoothly and with less risk of hemorrhage. In the case of large, fleshy pedicles this may be quite profuse, so that the surgeon should be prepared to give at once a douche of hot water, diluted vinegar, or tincture of iodine. If the bleeding continues and the uterus fails to contract promptly, its cavity should be tightly packed with gauze bandage, ergotin being administered hypodermically. It is advisable to go over the endometrium thoroughly with a sharp curette (avoiding the stump of the pedicle) in order to remove the granulations, which are the true cause of the menorrhagia. If smaller growths are discovered on palpation, they may be removed with the curette or with Emmet's curette-forceps—a useful instrument for seizing and withdrawing any neoplasm or foreign body from the uterine cavity, especially retained products of conception. The reader is cautioned never to grasp any neo-

plasm or tissue attached to the uterine wall with it, except under the guidance of the finger, since several cases of perforation have been reported in the hands of experts, who trusted too blindly to their experience and failed to recognize that the wall was abnormally thin or softened.

Modifications of the technique may be required under certain conditions. When a large tumor presents at the os, it may be advisable to split the cervix bilaterally in order to remove it, the wound being afterward closed with wire sutures like an ordinary laceration. Tumors the size of the fœtal head are sometimes delivered with obstetric forceps or removed piecemeal, as will be described later. The removal of sessile submucous fibroids, or of those which are partly interstitial and partly submucous, is an operation which should only be done by an expert. In spite of the mortality which attended it before the advent of modern asepsis, it was much more popular than it is at the present day, when hysterectomy has become so much easier and safer. Still, conservative surgery is always commendable, and when the uterus and adnexa can be spared without too much risk to the patient, and at the same time a permanent cure can be effected, the surgeon should follow the conservative course, especially if it is in accordance with the expressed wish of the patient. Under some circumstances palliative surgical treatment is advisable, especially where the patient is near the menopause, the only symptom being menorrhagia, and her general condition such that no risk is incurred in deferring a radical operation. The presence of a long, rigid cervix and the probability that the tumor is mostly intramural would contraindicate enucleation *per vaginam*. In such cases thorough curettage of the uterine cavity may check the hemorrhage for several months, and, even if it is repeated several times before the establishment of the climacteric, many patients would prefer this means of relief to incurring the risks of hysterectomy. With the electrical treatment of uterine fibroids we have nothing to do here: the hæmostatic effect of the galvanic current is practically the same as curettage—*i. e.* destruction of the hypertrophied endometrium. Necrosis of the tumor is an occasional ill result which should not be overlooked.

Ligation of the uterine arteries is another palliative operation which has been advocated, especially by Gottschalk and Martin, the purpose of which is to cut off the principal blood-supply of the uterus. The preparation of the patient is the same as for vaginal hysterectomy, the patient being in the dorsal position. Some operators simply draw the cervix downward and to one side, and sweep a large full-curved needle armed with heavy catgut upward and backward through the lateral vaginal fornix close to the uterus, aiming to carry it high enough to include the uterine artery, and to emerge an inch behind the point of entrance. The suture is tied tightly and a similar one is introduced on the opposite side. In the writer's opinion, this is a blind procedure, and in view of the variable distance of the artery above the base of the broad ligament it is impossible to tell positively whether the main trunk has been tied or only one of its lower branches. Moreover, the danger of wounding the artery or the bladder is not inconsiderable. Boldt prefers to open Douglas's pouch and to introduce the finger as a guide. He makes a semicircular incision around the cervix on either side and pushes the bladder upward, locating the artery by the touch and passing a catgut ligature from before

backward, afterward closing the wounds in the vaginal fornix. The after-treatment is simple, consisting in a light tamponade of iodoform gauze, renewed once or twice, followed by vaginal douches. The operation is limited to small intramural tumors of moderate size where the uterus can be drawn well downward. As to the results, we must accept the statements of those who have had considerable experience with the operation as regards the prompt relief of menorrhagia and diminution in the size of the uterus. Those who have observed the rich vascular supply of the broad ligaments during hystero-myomectomy must be somewhat skeptical with regard to the results obtained by ligating the uterine arteries alone.

Among other palliative or incomplete operations are simple dilatation of the cervix, which sometimes relieves hemorrhage and allows the uterine contractions to force the tumor down into the os, and splitting of the capsule of the tumor so that the blood-vessels retract and bleeding is checked. Ergot is administered after the latter procedure with the hope of causing extrusion of the growth. Partial removal has also been advocated—a procedure which does not commend itself to the surgeon for obvious reasons, especially the danger of sepsis.

For the successful performance of vaginal enucleation, or *morcellement*, it is necessary that the cervical canal should be thoroughly dilated beforehand, or that sufficient room should be obtained by free incision of the cervix, and that it should be demonstrated by careful examination that the bulk of the tumor projects into the uterine cavity. The tumor is seized with a stout volsella and is drawn downward into the cervix, or, if possible, through the os internum. While strong traction is maintained, portions of the mass are removed with scissors until the base is reached, when the operator proceeds more carefully, examining frequently in order to determine the thickness of the uterine wall over the tumor. The uterus may be partially inverted without danger. The organ contracts as the size of the growth is reduced, and assists in forcing it downward through the os; or the capsule of the tumor is incised freely at the most accessible point, and if possible it is shelled out entire with the finger or spoon-saw, downward traction being exercised as before. When complete enucleation is impossible, the tumor is removed by morcellation. As much of the capsule as is practicable is then excised with scissors, the cavity being packed with iodoform gauze.

Dangers.—Before beginning an operation for the removal of an intrauterine growth which presents at the os externum, or fills the vagina, it is important to determine the fact that it is a neoplasm, and not the inverted uterus. If, as sometimes happens, the diagnosis is doubtful, it is advisable to make a free incision into the mass, when its true nature will be apparent. Inversion may coexist with a tumor, in which case there is considerable danger of removing a portion of the uterus with the growth.

Hemorrhage is seldom profuse, as it is prevented by maintaining steady traction as well as by the uterine contractions. Occasionally the uterus is flabby and refuses to contract, but the gauze tamponade will excite contraction as well as arrest the bleeding.

Perforation of the uterine wall with the spoon-saw is most apt to

occur during the removal of sessile growths situated at the fundus. It is avoided by proceeding with great care when the base of the tumor is reached, hugging the growth with the instrument, and by making frequent bimanual examinations during the course of the operation. Should a small opening be made, no ill results need be feared in an aseptic operation, as healing will occur spontaneously if a gauze tampon is introduced. Larger perforations, especially if there is prolapse of omentum or a loop of gut, require immediate cœliotomy with suture of the wound, or hysterectomy, as may seem best after opening the abdomen.

Septic infection is to be feared when portions of the growth, or most of the capsule, is left behind; hence the necessity of thorough removal. Subperitoneal fibroids impacted in Douglas's pouch, especially those springing from the lower uterine segment, can be removed through the posterior vaginal fornix, the technique being the same as in vaginal oöphorectomy (*q. v.*).

MALIGNANT NEOPLASMS.—The consensus of opinion in regard to malignant disease of the uterus now favors complete extirpation if the case is in the operable stage, but, since in this country at least, only about 5 per cent. of the patients who are referred to the surgeon can be regarded as favorable subjects for a radical operation, it follows that he is frequently called upon to adopt palliative measures with the view of relieving symptoms and prolonging life.

Operations for Malignant Disease.—While it is impossible to enter exhaustively into this subject, it may be stated in general that total vaginal extirpation of the uterus is now regarded as proper treatment for carcinoma of the cervix in its incipient stage, but it is impossible to ignore the favorable statistics of those who still believe that the disease can be as thoroughly treated by amputation of the cervix alone, while the mortality is much lower. The surgeon must be guided in his decision as to the amount of tissue to be removed by the extent of the disease and the involvement of the surrounding part, as well as by the general condition of the patient. When it is confined to the *portio*, or the cervix proper, the uterus being freely movable, without infiltration of the broad ligaments, so-called high amputation is performed. Even when the disease has extended to the vagina it is possible to excise the intravaginal portion of the cervix and remove the neoplasm entirely. In advanced cases with extensive ulceration, where the broad ligaments are generally involved, thorough curettage of the cervix and cauterization are alone admissible.

High Amputation.—The patient may be either in the dorsal or lateral posture. The redundant portion of the growth having been removed with a sharp spoon, and the cervix seared with the thermo-cautery, the cervix is seized with a strong volsella and is drawn forcibly downward. An incision is then carried around the vaginal roof at least half an inch outside of the actual limit of the disease. Still making firm traction, the operator dissects off with blunt-pointed scissors or the finger the bladder in front, the posterior wall of the vagina behind; the bladder is pushed upward to the level of the os internum, while behind the dissection is carried up as high as Douglas's pouch. The bases of the broad ligaments are exposed laterally. If the disease is limited to the portio vaginalis, the cervix alone may now be amputated,

a cone-shaped portion being removed, the apex of which is the os internum. If the disease has extended as high as the body of the uterus, the stump is drawn down and a second cone-shaped portion is removed, its apex being well above the os internum. The hemorrhage is usually slight as long as firm traction is exerted on the cervix, but as soon as this is relaxed it is apt to be quite profuse, sometimes necessitating ligation of the uterine arteries. This operation may be made so thorough as to leave scarcely more than one-third of the uterus. The raw surface, after thorough irrigation, is dried, charred with the galvano-cautery or Paquelin, and packed with iodoform gauze. There is usually slight reaction after this operation, the patient making a rapid recovery. It is important that the sound should be passed at intervals for several months in order to ensure patency of the canal.

The same operation is performed, but more thoroughly and with less risk of hemorrhage, by the galvano-cautery, as advocated by Dr. Byrne. His operation is briefly as follows: As much of the diseased tissue as possible is scraped away with a sharp spoon, and the surface is then thoroughly charred with a dome-shaped cautery. The cervix being drawn down with the volsella, a circular incision is made around it with the cautery-knife raised to a dull heat. Maintaining the traction, a large cone-shaped mass is then excised, the apex of which is within the os. The excision is conducted very slowly with a moderate degree of heat, which effectually controls any hemorrhage. The peritoneal cavity is sometimes opened posteriorly, but rarely with any ill effect, the action of the cautery being aseptic, as well as destructive to outlying groups of cancer-cells.

The after-treatment is very simple, and consists in the application of a tampon saturated in a styptic solution of acetic acid. The uterine arteries are frequently divided in this operation, yet so effectual is the hæmostatic action of the cautery that they rarely give trouble. After the cervix has been removed, a dome-shaped cautery is carried up into the uterine cavity and its interior is thoroughly charred.

In an advanced case of malignant disease considerable benefit is afforded by curettage of the diseased tissue, followed by cauterization. Not only is the ulcerating process temporarily arrested, but the hemorrhages are checked, and a healthy granulating surface is substituted for the former sloughing tissue. This operation, though simple, requires considerable care. Extended observation has convinced the writer that when the disease has extended to the body of the uterus and the patient's health has become seriously affected the operation is of doubtful utility. The ordinary Simon's spoon and volsella are the only instruments needed. The spoon should be used freely for the removal of all exuberant cancerous tissue. Especial care should be exercised to avoid perforation of the bladder and rectum, as the septa are sometimes extremely thin. At the beginning of the operation it is wise to introduce a sound into the bladder in order to exactly locate the position of this viscus. A curette may be used within the uterine cavity and a considerable portion of the organ removed. The operator should always remember that the danger of perforating the wall is not a slight one. Hemorrhage is often quite severe, but is controlled by charring the tissues with the Paquelin cautery. A tamponade of iodoform gauze, preceded by the application of equal parts of iodoform and tannin to the charred surface, is an effective dress-

ing. It is to be removed at the end of forty-eight hours and the patient given daily irrigations of creolin, 1 : 600 or 1 : 800.

Operations for Traumatism.—Laceration of the cervix is a lesion the importance of which was originally pointed out by Dr. Emmet, with whose views the profession is familiar. It should be stated, however, that among the modern school of gynecologists there are some who not only deny the pathological importance of the condition, but claim that Emmet's operation is unnecessary. The indications for the operation are more limited than formerly supposed and greater care is exercised in selecting cases.

Operations upon the cervix may be immediate or secondary.

Immediate Trachelorrhaphy.—The writer once took the position that immediate closure of a lacerated cervix was not only unnecessary, but unjustifiable except for the prevention of alarming hemorrhage. Serious tears of the cervix extending to the vaginal junction and involving the circular artery are most apt to occur in difficult deliveries, especially after version, when the cervix has been incompletely dilated. The hemorrhage may be so profuse as to make it necessary to insert sutures at once in order to save the patient. The immediate operation is by no means an easy one, since it requires a good light, skilled assistants, and proper instruments, all of which are usually absent in the lying-in room.

After every difficult labor in which hemorrhage persists in spite of thorough contraction of the uterus the accoucheur should at once suspect that the cervix has been extensively lacerated. It is not always easy to recognize the nature of the injury immediately after delivery, since the parts are so relaxed and contused that it is difficult to distinguish the line of separation between the cervix and vagina. The laceration may be unilateral, usually on the left side, but in the cases to which reference is made it is generally bilateral. The patient, still under the influence of an anæsthetic, is drawn down to the edge of the bed with the knees flexed and the feet supported by a nurse or assistant on either side. By retracting the perineum with a speculum the parts are brought more clearly into view, but since this instrument is often absent the operator may seize the anterior lip of the cervix with a volsella and draw it down to the vulva. Then, during constant irrigation or sponging with pledgets of absorbent cotton, he passes a large curved needle threaded with stout silk or silkworm gut deeply beneath the angle of the tear, his object being to secure the torn artery. This suture is tied and held by an assistant, and other sutures to the number of three or four are passed through both lips of the cervix. Care should be taken not to close the os too tightly, in order to allow ample room for drainage of the secretions. The sutures are left long, and the vagina is thoroughly irrigated with an antiseptic solution. If the perineum is torn, it is repaired at once. The writer has had the satisfaction in two cases of feeling that he probably saved the life of his patient by prompt resort to this measure. He has recently extended the operation in private as well as hospital practice to cases without hemorrhage in which the existence of extensive tears was recognized. The result has been most gratifying, the cervix being restored to its normal condition after involution. The immediate operation under these circumstances is indicated not only

to prevent future trouble, but also to eliminate the possibility of sepsis by promoting immediate union of the torn surfaces. It was formerly believed that the tissues were so contused that union would not take place, but later experience has proved that this is not the case. As before stated, the operation should not be performed blindly: the surgeon must see exactly what he is doing, else he may insert the sutures, not through the cervix, but through the vagina, or may even pass them into the peritoneal cavity.

Intermediate Trachelorrhaphy.—By this term we understand suture of the torn cervix within a few days or weeks after the injury has occurred—that is, before the uterus has undergone complete involution. Excellent results have been obtained in this way, but, aside from the objections which would naturally be raised by the patient who has undergone a severe labor to having another operation during the puerperium, is the fact that the tissues are often so soft and in such an unhealthy condition that union does not take place.

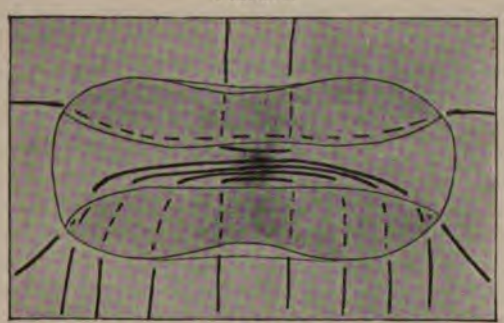
Emmet's operation is indicated in cases of unilateral or bilateral laceration of the cervix extending to the vaginal junction, accompanied by more or less erosion and induration. If for no other reason, its performance under these circumstances should be regarded as a wise prophylactic measure, since these erosions are unquestionably the frequent cause of the development of epithelioma. Most gynecologists admit that subinvolution of the uterus and endometritis are directly due to this condition, while a smaller number refer many neuroses to the torn cervix. It used to be customary to subject the patient to weeks or months of preparatory treatment before performing the operation, but now this is usually regarded as unnecessary. Among the contraindications to the operation are such conditions as would not be eliminated by the operation itself, but would persist as causes of discomfort and ill-health. For example, there would be no object in repairing a torn cervix in the case of a patient with a uterine neoplasm, or with displacement and fixation of the organ, or with tubal or ovarian disease which was really the cause of the symptoms. The most favorable results are obtained in cases of uteri which are freely movable, and where there is no evidence of acute or subacute disease of the perimetric tissues. It should also be remembered that where laceration and relaxation of the pelvic floor coexist, repair of the cervix alone is simply one step in the treatment, since it is necessary not only to restore the cervix to its normal condition, but to provide adequate support for the enlarged uterus by repairing the floor.

It is, as stated elsewhere, the common practice to operate upon the cervix and perineum at one sitting. Endometritis being a constant accompaniment of lacerated cervix, thorough curettage of the uterine cavity should be performed as a preliminary step to trachelorrhaphy. It is frequently necessary to dilate the cervical canal in these cases, especially if there is any contraction at the os internum.

Operation.—The patient, having been prepared as for other gynecological operations by shaving the pubes and thorough disinfection of the external genitals and vagina, is placed either upon the back or in the Sims position. The majority of gynecologists still prefer the latter, but the dorsal posture offers many advantages, especially if it

is proposed to perform perineorrhaphy at the same time. If the patient is on the back, the legs are supported by the usual braces. A Sims speculum is introduced, and is held by a nurse on the right. The assistant to the left sponges. The operator sits upon a low chair, his back to the window, with a table at his side on which are placed the instruments, ligatures, and sutures. Few instruments are necessary for

FIG. 370.



Introduction of sutures in trachelorrhaphy.

this operation—a small volsella, two or three tenacula, an ordinary pair of sharp-pointed uterine scissors, wire scissors, a needle-holder, shield and twister, needles, and silkworm gut or No. 26 or 27 silver wire. The scissors devised by Dr. Boldt the writer has found especially useful in this operation. The cervix is firmly grasped with the volsella, which is held by an assistant. The surgeon should learn to operate without drawing the cervix down—*i. e.* the uterus being *in situ*—since damage may be done by making too strong traction on the cervix. After curettage and irrigation of the uterine cavity the operator inserts his tenaculum deeply beneath the angle of the tear on the left side and with the scissors marks out the line of incision. This is a useful preliminary step, for it prevents him from making too deep a cut. Considerable judgment is necessary with regard to the amount of tissue to be removed. A timid operator may excise too little, while the bold and rapid surgeon may make his preliminary incision so deep in the angle of the tear as to enter the subperitoneal space. The aim should be to remove all cicatricial tissue and to leave a fresh, even surface on each lip. In cases of extensive laceration where considerable tissue is removed a branch of the circular artery may be divided, which gives rise to a smart hemorrhage. This is readily controlled by passing a needle beneath the angle of the tear and twisting a wire, which is then handed to an assistant to hold. A similar denudation is made on the opposite side, the operator being careful to leave an undenuded strip of mucous membrane on each lip at the site of the cervical canal. Having irrigated the raw surfaces thoroughly, the next step is the introduction of the sutures. The best needles are Emmet's curved trocar-pointed. They should be of moderate length, with large eyes. It is customary to pass the sutures first on the right side. The first suture is entered about a quarter of an inch from the raw surface, on the posterior lip, close to the angle. It is

passed almost at right angles to the axis of the canal and emerges deeply beneath the denuded surface. It is then inserted at a corresponding point anteriorly, is carried under the denuded surface again, and is brought out at a point equidistant from the angle on the anterior lip. Since the tissue is quite hard, it is necessary for the operator to make counter-pressure with a tenaculum at the place where the point is to emerge. The needle is then drawn through, carrying with it a loop of linen thread in which is hooked a silver wire about eight inches long. The ends of the wire are brought together with a slight twist and are given to the nurse to hold. From three to six sutures are passed in this way, the last one being carried almost transversely from one lip to the other, just at the edge of the undenuded mucous membrane. In some cases, where one lip is longer than the other, it is necessary to include more tissue in the redundant portion. The sutures are passed in the same way on the opposite side. The raw surfaces are again irrigated, and the operator proceeds to the third step, which consists in twisting the sutures. Grasping the two ends of the suture with the wire-twister about an inch from the wound, the extra portion of the wire is cut off with special scissors. The surgeon then twists from right to left, the assistant carefully bringing together the edges of the wound with a tenaculum. The loop is twisted close down, but not so tightly as to unduly constrict the tissues. In order to prevent this a little manœuvre called "shouldering" is practised. This consists in bending the loop on each side so that it shall lie directly over the line of the wound. It is maintained in this position by the shield. After each suture has been twisted the loop is loosened or drawn out so as to prevent constriction. It is then held with the twister; the tenaculum is slipped under the wire and it is bent backward at a right angle so as to lie closely in contact with the surface (Fig. 371). It is then cut off, leaving only half an inch of the twisted wire. The success of the operation, aside from the thorough removal of the diseased tissue, depends upon the manner in which the denuded surfaces are brought together. A proper appreciation of the amount of tension employed in twisting the wires can only be acquired by long experience. It should be said that beginners are apt to twist them too tightly. Due allowance should be made for swelling, as otherwise the sutures will cut their way out and the result will be unsatisfactory. The two sutures nearer the canal on either side, known as the "crown sutures," are secured less tightly, as at this point there is the greatest amount of tension. The last step of the operation consists in testing the patency of the canal by passing a large-sized sound. If the operator is at all doubtful, it is better to cut one of the sutures rather than to run the risk of subsequent stenosis—a mortifying result which has occurred in the practice of the best operators. This is still further

FIG. 371.

Sutures twisted and cut short after trachelorrhaphy.

obviated by introducing a strip of iodoform gauze into the cervical canal, which also secures drainage after curettage.

The subsequent **treatment** of these cases is exceedingly simple. It was formerly the custom to give douches once or twice daily, which not only failed to prevent sepsis, but frequently interfered with proper healing. Now no douches are given during the first week except for special indications.

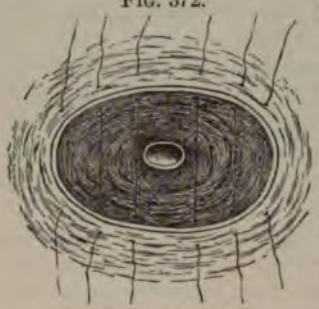
The dangers of this operation are practically *nil.* Sepsis should never occur: when it does it must invariably be attributed to some fault in the technique. The writer long ago pointed out the fact that in the fatal cases on which he had performed autopsies the condition was invariably found to be septic peritonitis, which had been transmitted directly from the wound through the uterus to the peritoneum. It was formerly supposed that inflammation of the pelvic tissue (cellulitis) might be lighted up purely as a result of traumatism—an opinion which is of course at variance with modern surgical views. It is hardly necessary to add that no careful surgeon would think of operating upon a patient who was suffering from a subacute inflammatory condition of the adnexa or pelvic tissues, as it would be aggravated by the operation. Convalescence after this operation is usually afebrile, though a temperature of 100°, or even 101° F., is not infrequently observed. It should be viewed with suspicion, however, especially if the temperature is elevated for several days after the operation. When sepsis occurs the same rules must be followed as in a wound elsewhere; that is, the stitches must be promptly cut, the cervix laid open, and the sloughing surface thoroughly cauterized and irrigated.

Schroeder's is often confounded with Emmet's operation; it is particularly applicable to obstinate cases of cervical endometritis. In this operation the cervix is first split laterally if necessary, and a cone-shaped portion of tissue removed, including the whole of the diseased cervical endometrium and a portion of the connective tissue beneath it. If the cervix is sufficiently long, the two flaps which are so formed are then doubled upward and secured by interrupted sutures of silk or silkworm gut. A more extensive excision is necessary in cases of bilateral laceration of the cervix accompanied by hypertrophy and general induration. It may be said that this operation has to a considerable extent supplanted the less radical procedure of trachelorrhaphy. It is to be recommended in every case in which the cervix is so generally indurated that portions of diseased tissue would be left even after the ordinary incisions for trachelorrhaphy had been made.

Amputation of the Cervix.—With the patient in the same position as for trachelorrhaphy, the anterior lip being grasped with a volsella, the operator first encircles the portio with an incision which is carried close to the reflexion of the vagina. Deepening this incision, which is carried up almost to the level of the os internum, he removes in one or several pieces all the indurated tissue which can be seen or felt, leaving simply two vaginal flaps. A large raw stump is now left similar to the stump left after circular amputation of a limb. The hemorrhage is moderate as long as traction is exercised on the cervix. The mucous membrane of the canal is of course excised with the rest of the diseased tissue. The sutures are now passed in the following

manner: The needle is introduced through the vaginal mucous membrane of the anterior lip, and then into the connective tissue close to the cervical canal, and is brought out in the canal; a similar suture is passed at the side of the first. Two sutures are introduced in the same way, the first through the mucous membrane of the canal, and then through the vaginal mucosa posteriorly. The stump is now covered with a vaginal flap, and the other sutures are passed through the vaginal mucous membrane, then deeply into the tissue of the cervix, and finally out through the vaginal mucosa of the posterior lip, three or four being introduced on each side of the canal. They are twisted in the ordinary manner. The sutures which enter the canal are then twisted. These bring the mucous membrane of the vagina and cervical canal together, and thus maintain the patency of the latter. In order to prevent contraction the writer is accustomed to introduce a plug of iodoform gauze or, better, an Outerbridge's dilator, which is left in position for a week or ten days. Amputation of the cervix differs from excision in the fact that the original incision is made not in the cervical tissue, but through the vaginal mucous membrane. The wound is closed in the same manner.

FIG. 372.



Amputation of the cervix.

In every case the cervix sutures should be left in position for at least ten days, preferably for two weeks. Where a combined operation has been done they are frequently not removed for three or four weeks, as they are not irritating. Silkworm gut is quite satisfactory as a suture material. A few operators prefer silk, or even catgut. The latter, unless chromicized, is open to the objection that it is apt to dissolve before complete union takes place, and also that the tension is often so great as to cause slipping of the knot.

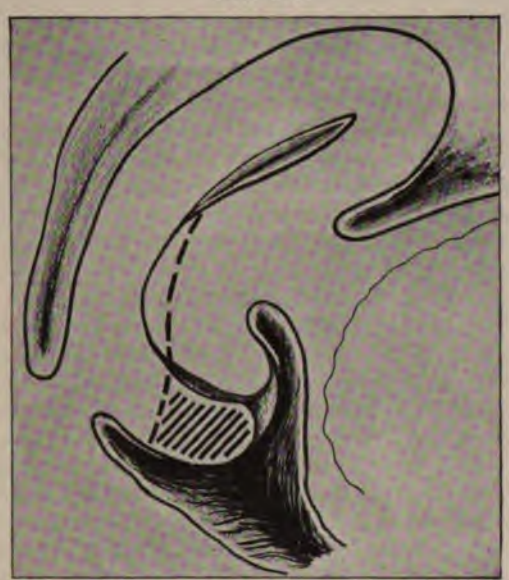
OPERATIONS FOR DISPLACEMENT.

ANTEFLEXION.—The indication in the operative treatment of anteflexion is not so much to effect permanent straightening of the bent uterus as to overcome the obstruction of the cervical canal due to the presence of an angle. In less marked degrees of deformity it may be overcome by thorough divulsion, followed by the insertion of some form of intra-uterine stem of glass, hard rubber, or wire, which is worn for several months, especially during the menstrual period. A patient wearing a stem should be kept under careful observation, and the instrument should be promptly removed whenever serious symptoms arise. The majority of gynecologists at the present day have rejected the stem or only use it when the patient is confined to her bed.

Discission, or Dilatation with Cutting Instruments.—This operation was first performed by Simpson, and consisted in passing a metrotome through the os internum, expanding the blades, and withdrawing it. It is introduced again and withdrawn in the opposite direction, the cervical canal being divided bilaterally. Sims performed the operation

with the patient in the left lateral posture, the anterior lip being steadied with a tenaculum. The posterior lip of the cervix is divided with angular scissors as high as the vaginal junction. A special form of knife, the blade of which is set at an angle to the handle corresponding to the curve of the uterine canal, is passed through the os internum and a small incision is made from the os internum to the upper end of the

FIG. 373.



Anteflexion of uterus, showing Sims's posterior discission.

external incision. A similar incision is made through the anterior wall of the cervix. The os internum should be sufficiently divided to admit the passage of a Peaslee's sound one-fourth of an inch in diameter. If additional dilatation is desired, a large-sized branched dilator may be used. A hard-rubber plug about two inches long is introduced at once, and is kept in position with a tampon for five or six days.

Antero-posterior Division.—As performed by Dr. Emmet the operation is varied according as it is performed for anteflexion of the cervix or of the body of the uterus. In the former condition the posterior lip is divided and the posterior wall of the cervix incised as high as the os internum; in the latter, the anterior wall is divided from the os internum as low as the upper end of the incision in the posterior lip. This operation has fallen into disrepute for the reason that there is no guide as to the proper depth of the incision, this being purely a matter of experience. Several cases of profuse hemorrhage from division of the circular artery have been reported, and in former years the operation had a considerable mortality from septic peritonitis, which of course would be eliminated under modern aseptic precautions. The permanent result of the operation, especially when performed for the cure of dysmenorrhœa and sterility, is doubtful. In a case of anteflexion with marked hypertrophy of the cervix circular amputation is sometimes indicated.

An ingenious operation devised by Dr. E. C. Dudley of Chicago for the cure of pathological anteflexion should be mentioned. The technique is briefly as follows: After thorough divulsion, curettage, and irrigation of the uterine cavity, the posterior lip of the cervix is divided with angular scissors through the vaginal junction. The wound is separated by tenacula, and the incision is still further deepened with a knife. Each lateral flap is now turned down into the angle and attached with silkworm-gut sutures, the result of which is to carry the os externum backward and upward. The anterior lip of the cervix is then caught with a tenaculum, and is partly excised as high as the edge of the os. This transverse wound is then closed antero-posteriorly with silkworm gut, thus throwing the os still farther backward.

Acquired anteflexion, due to inflammatory shortening of the sacro-uterine ligaments, will of course not be relieved by any operation so long as permanent traction is exerted on the cervix. It has been suggested in these cases to open the posterior fornix and divide the shortened ligament—an operation which may be performed with impunity under our present technique.

Retroversion.—It is hardly necessary to remind the reader that in almost every case of retro-displacement there are several pathological conditions which favor the abnormal position of the uterus. Excepting in rare cases of acute backward displacement in nulliparous women there is not only a weakening of the natural supports of the uterus—the pelvic floor, uterine ligaments, etc.—but the organ itself is overweighted, and thus tends to sag below its normal plane. The symptoms in all these cases, as is well known, are due not so much to the fact that the uterus lies forward or backward, as that it is also more or less prolapsed.

The selection of an operation for the cure of this condition will then depend in each individual case upon the prominence which is assigned to the different pathological factors. It is for this reason that one operation alone seldom fulfils the indications or is likely to be followed by permanent benefit. Thus, to suspend the heavy uterus by the shortened round ligaments without strengthening its lower supports, and to rely upon plastic operations on the cervix and pelvic floor when the uterine ligaments are entirely relaxed, are equally unscientific.

The indications differ according as the uterus is fixed or movable. In simple retroflexion with fixation, unattended with disease of the adnexa, the adhesions may sometimes be stretched or broken up by a judicious practice of Schultz's method or of Brand's pelvic massage, followed by the insertion of a pessary or a subsequent Alexander's operation.

It would be out of place to enter upon a discussion of the conservative *versus* the surgical treatment of displacements. Many patients prefer to wear a pessary rather than submit to operation, but in a considerable proportion of cases the instrument is either not tolerated or affords no support in consequence of relaxation or lesion of the pelvic floor.

Colpo-hysteropexy.

Various operations have been devised having for their object the fixation of the uterus in its normal position by the attachment of either the cervix or fundus uteri to the anterior or posterior vaginal wall. Riche-

lieu, followed by Hunter and Byford, has sutured the posterior lip of the cervix to the posterior vaginal wall, and has even fastened the anterior lip of the cervix in the same way, although the results have not been permanent. When the anterior vaginal wall is abnormally shortened, Skutsch proposed to lengthen it by making a transverse incision, closing it in a vertical direction. Sims had previously performed a similar operation. The results have never been permanent. Schücking has performed the following operation, of which he thinks highly, although it has fallen into disrepute on account of the danger of injuring the bladder: The uterus is strongly anteverted with a sound. A sound is introduced into the bladder and carried forward by an assistant. A strongly curved, cannulated needle carrying a stout silk suture is introduced to the fundus; the needle is pushed through the uterine wall and vesico-uterine septum below the bladder, and pierces the vaginal fornix just in front of the cervix. The needle is withdrawn, and the two ends of the ligature are then tied. The uterus is thus fixed in a position of exaggerated anteflexion. The suture is left in position for about two weeks, when it is removed. Although the operation has been permanently successful in his hand, it is a blind one, and there is not a little danger of wounding the bladder, as has occurred in several cases. It has never become popular in this country.

Mackenrodt's method of vaginal hysteropexy deserves more consideration, as it has been performed by a number of operators in this country and abroad with satisfactory results. The technique is as follows: A median incision is made in the anterior vaginal wall, extending from the portio vaginalis to the most prominent part of the urethro-vaginal septum. The flaps are then separated and dissected off laterally. The cervix is drawn forcibly downward and the bladder is dissected off as high as the vesico-uterine fold. The uterus is strongly anteverted, and the raw surface of the bladder is closed with a continuous catgut suture. Two silk sutures are next passed from the right to left through the edges of the vaginal wound, then into the corpus uteri as high as possible, the vesico-uterine fold being included. They are crossed in front of the vaginal wound and are tied. The vaginal wound is then closed with a catgut suture. The silk sutures are left in position from four to six weeks, when the body of the uterus becomes adherent anteriorly through the union of the opposed folds of the vesico-uterine pouch. If the cervix is much elongated, it is amputated. Dührrsen has simplified the technique by opening the anterior fornix and elevating the bladder with the finger and catheter, while drawing the cervix downward and backward. The uterus is anteverted, and the fundus is drawn downward with temporary sutures until the vesico-uterine pouch can be reached, when the permanent sutures are introduced as before. The patient is kept in bed for a week only.

ALEXANDER'S OPERATION.

This operation is indicated in cases of movable displacement without disease of the adnexa, in which the patient is unable or unwilling to wear a pessary. As before stated, it is supplemented by curettage and operations on the cervix and pelvic floor where the necessity for these

exists. It is less apt to be permanently successful in cases of prolapse in which there is a large, heavy uterus. It is an operation requiring considerable practice, and the majority of the failures, in the experience of most operators, have occurred in their early operations.

The preparation of the patient should be as thorough as for a laparotomy. Curettage, followed by operation on the cervix, if indicated, is first performed. If it is necessary to repair the pelvic floor, this step is usually left until the last, although it may be done at once. Most surgeons insert a pessary at the close of the operation, although this may be done as a preliminary measure. The operator, standing on the right side of the patient, first locates the pubic spine, then makes an incision an inch to an inch and a half long, extending from the pubic spine upward and outward parallel with Poupart's ligament, through the skin and fat down to the fascia of the external oblique muscle. The external ring is felt for, the tissues are separated by the thumb and index finger, and the intercolumnar fascia is identified. A small quantity of yellow fat usually protrudes into the wound. This is grasped gently with forceps, traction is made upon it, and some fibres of the ligament are recognized. The ligament appears as a reddish cord, which is seized with blunt forceps and isolated with the handle of the scalpel or blunt-pointed scissors. It is gradually drawn out of the wound, adherent tissue being stripped off with the finger-nail or a blunt instrument. The uterus is now replaced, if it has not been done previously, with the sound or the finger, and the ligament is drawn out until the pouch of peritoneum appears. This is also stripped up, and traction is continued until the large uterine portion of the ligament is recognized. The average amount of ligament drawn out is about four inches. The first wound is then covered with antiseptic gauze, and the other ligament is found and dissected out in the same manner. While each ligament is kept tense by an assistant, a curved needle threaded with silk or chromicized catgut is passed through the external pillar, the ligament, and then through the internal pillar. A second suture includes the lower portion of the ligament. The external incision is then closed with two or three silkworm-gut sutures. If there has been considerable wounding of the tissues, a small drain of horsehair or silkworm gut is introduced and left for a few days. The redundant portion of the ligament is then cut off. An antiseptic dressing is applied and is secured by a double spica bandage. The patient should be kept in bed for three weeks.

Various modifications of this operation have been introduced, one of the most ingenious of which is Cleveland's. He passes a ligature-carrier through the lower end of the insertion under the fascia, and pushes it through the skin over the mons at a point an inch below the pubic spine. A loop of silkworm gut is drawn through with the carrier; the end of the ligament is placed in this loop and is pulled through the opening in the skin, where it is secured by an additional suture. The excess of ligament is then cut off. This affords an additional anchorage for the ligament. The same operator avoids buried sutures, and passes two or three sutures of silkworm gut through all the tissues, including the pillars of the ring and the ligament, leaving them in position for two or three weeks. He uses a moist dressing of 1 : 3000 bichloride. The patient should wear a pessary for several months after the operation.

The principal causes of failure are inability to find the ligaments; not drawing them out sufficiently; the presence of abnormalities of the ligament, especially where it is so thin and delicate that it does not afford sufficient support. Suppuration is by no means infrequent, especially if rigid aseptic precautions are not observed, but even where the wounds heal by granulation a good result is generally obtained.

The occurrence of hernia after the operation is by no means infrequent, especially in cases in which the intercolumnar fascia has been divided and the inguinal canal opened. When this has been done additional care should be exercised in suturing the pillars of the ring.

When the displacement is complicated by adhesions of the uterus or adnexa, ventral fixation, after opening the abdomen, is indicated, but Polk has demonstrated the practicability of Alexander's operation even in these cases after separating the adhesions by way of an incision in the posterior vaginal fornix.

Operations for Prolapse of the Uterus.

A moderate degree of prolapsus may be cured by the ordinary plastic operations already described. When there is accompanying hypertrophic elongation of the cervix, the latter should first be amputated. Alexander's operation is adapted to these cases when the uterus is not too heavy. In complete procidentia an operation recently devised by Fritsch is quite successful. It is only adapted to cases in which women have passed the menopause or where sexual intercourse does not take place. No denudation is necessary. A silver-wire suture is made to encircle the vaginal wall just above the cervix, the needle being entered in the median line in the posterior vaginal wall and the suture carried entirely around beneath the mucous membrane, emerging near the point of entrance. It is twisted tightly and the ends are cut short. The cervix is then pushed up, and a similar "purse-string" suture is introduced about half an inch below the first, and this is also twisted. Three or four sutures are inserted in this way, the last of which contracts the vaginal orifice, leaving a small canal through which any secretion from the uterus can escape. The patient is placed in bed for a few days, rarely more than a week. Since the sutures are permanent, it is necessary to observe strict asepsis. The operation is an extremely simple one, as no denudation is necessary, and it may even be performed without an anæsthetic.

Le Fort's Operation.—This aims at curing the prolapse by closing the vagina through adhesion of its anterior and posterior walls. It is adapted to the same class of cases as the former operation. The writer's technique differs somewhat from that ordinarily followed. If there is a deep bilateral laceration of the cervix with erosion, which may give future trouble, he has no hesitation in first closing it with catgut sutures or performing amputation. Seize the cervix with a volsella and draw it strongly downward. With mouse-tooth forceps and scissors denude a parallelogram on the anterior vaginal wall at least one and a half by three inches (even larger if there is much redundant tissue), the lower edge of which is at the junction of the cervix and vagina. Bleeding is checked by pressure with gauze pads. Draw the cervix upward and

denude a corresponding surface on the posterior vaginal wall. Enter a curved needle with No. 2 catgut in the raw surface near the lower edge of the anterior wound, skip over the cervix, and re-enter it at a corresponding point in the posterior wound. Four sutures are thus introduced in a row and tied, while an assistant pushes up the cervix, inverting it like the finger of a glove. When these are tied the cervix is concealed. From six to eight rows of sutures are introduced in the same way. When the last row is tied the two raw surfaces should be in exact apposition, and the vagina is now closed almost as low as the meatus. Perineorrhaphy is then performed by the flap-splitting method, thus closing the vagina nearly as high as the vestibule; a pad of gauze is placed over the vulva, held by a firm T-bandage. The urine should be drawn for a few days and the bowels are kept rather loose. The patient should be kept in bed for a couple of weeks, and should avoid any severe muscular effort for several weeks. With strict asepsis healing ought to be perfect. Drainage from the cervix is provided for by the canal which is left on either side of the vagina.

The result is in the main excellent. Even if the tissues do become relaxed in time, the procidentia does not return, and the moderate cystocele and rectocele which result are a great improvement on the original condition.

Operative Treatment of Inversion of the Uterus.

Before resorting to any surgical measures for the relief of this condition an attempt should be made to replace the inverted organ. A number of ingenious methods have been devised, many of which rely upon taxis alone, or upon taxis combined with gradual pressure by means of air- or water-bags or specially devised instruments. Rapid reduction has been effected in several different ways. Emmet has recommended stretching the contraction-ring by introducing two fingers within the cervix, while counter-pressure and dilatation are simultaneously effected by pressure upon the ring through the abdomen. Noeggerath proposed placing the index-finger upon one horn of the uterus while pressure was made with the thumb upon the other, so as to invert one or both cornua. Courty passes the index and middle fingers into the rectum and makes pressure on the edges of the ring from above, while an attempt is made to push up the inverted uterus *per vaginam*. These are only a few of the methods of manual replacement. If repeated careful attempts at taxis are unsuccessful, prolonged graduated pressure is resorted to. Among the specially devised instruments are the repositors of Aveling and Byrne, which are in effect cup-pessaries, the outer end of which is provided with powerful springs. They are secured with suitable bandages. Rubber bags inflated with air or water exert powerful pressure with less danger from sloughing of the soft parts.

In a certain number of cases all these attempts will be unsuccessful. It is then proper either to amputate the inverted organ or to extirpate it entirely. The latter method commends itself to modern surgeons. Amputation is by no means free from danger, since the prolapsed intestine may be injured, and there is considerable risk of hemorrhage. There are several methods of amputation—viz. with the knife or scissors,

the écraseur, the elastic ligature, and the galvano-cautery. All these methods, which aim at the immediate removal of the inverted organ, involve some risk. Courty recommends the application of a rubber ligature, which is gradually tightened and left in position for nearly two weeks, but, since this involves sloughing *en masse*, it can hardly be regarded as surgical. Hegar and Kaltenbach constrict the cervix as high as possible with a wire or silk suture before amputating. In some cases in which the uterus can be partially replaced Emmet has recommended closure of the cervix with wire sutures, which prevents extreme inversion, but is, of course, not a curative measure.

Combined Operations.

The improvement in the technique of gynecological surgery is clearly shown by the facility with which several operations are now done at one sitting which a few years since were performed separately. Thus, four and even five operations are done at one time, including abdominal section. The main requisite is rapidity of execution. As this presupposes special training and skill in technique, since the patient ought not to be under ether more than from one to one and a quarter hours, the general practitioner will hardly practise these as extensively as the specialist. Thus, it would not be advisable for the occasional operator to do a ventro-fixation, or shortening of the round ligaments, followed by trachelorrhaphy, anterior and posterior colporrhaphy, since the former operation might detain him too long; but there is no reason why he should not perform the necessary plastic operations at once, thus saving the patient time, pain, and repeated etherization. If these are all done with the patient on the back, no time is lost in changing her position, constant irrigation can be maintained, and fewer assistants are required —an important gain in private (and especially in country) practice. Moreover, the dorsal posture is most favorable for anæsthesia. As regards the choice of operations, the writer has no desire to urge the advantages of any special method, but he has found in his own experience that in an ordinary case of laceration of the cervix and pelvic floor, with rectocele and cystocele, the following mode of procedure will be found to be not only the most convenient, but the most rapidly performed:

With the patient in the lithotomy posture at the edge of the table (her legs being supported with the apparatus before described), the assistant on her left and the nurse on her right, the operator seizes the anterior lip of the cervix with a volsella or bullet-forceps. The nurse retracts the perineum (which is often unnecessary) with a Sims speculum and holds the volsella. The cervix is then dilated and the uterine cavity curetted and irrigated, after which trachelorrhaphy or amputation of the cervix is performed, as may be required, wire sutures being used. Next a Martin's, Stolz's, or Sims's anterior colporrhaphy is performed, using buried catgut or silkworm-gut sutures according to the amount of redundant tissue. Hegar's (or Martin's) posterior colporrhaphy can not only be done rapidly, but gives excellent results. These operations may easily be finished by an expert in an hour (especially if he has skilled assistance), while one who is not familiar with the operations should do them in an hour and a half.

The *after-treatment* is simple, as the vaginal sutures may be left *in situ* for two or three weeks, when they are removed at the same time with those in the cervix. Vaginal injections need not be given during the first week. If perfect asepsis has been secured, there need be no doubt as to the result, any more than when a single operation is done.

Operation for Pelvic Abscess.

It frequently becomes necessary to evacuate intrapelvic collections of fluid through the vagina. In this way suppurating ovarian cysts, hæmatoceles, and abscesses of the tubes and ovaries or cellular tissue may be reached successfully and drained. Aspiration is now resorted to almost entirely as a diagnostic measure, the pus being evacuated by a free incision as soon as it is located. Nothing is simpler than to tap and incise a large abscess which bulges prominently through the roof of the vagina, but smaller collections of pus in and around the tubes and ovaries are often reached with great difficulty because of their location, the absence of fluctuation, and the presence of extensive exudate, which must be traversed before the pus is reached. No special rule need be laid down except that which is applicable to all cases of deep-seated suppuration—*i. e.* before plunging in a needle to the depth of one or two inches the anatomy of the parts should be carefully recalled. The line of safety is well behind the broad ligaments. The attempt to open abscesses within the broad ligaments or in front of the uterus involves considerable risk of injury to the blood-vessels and to the bladder. In some cases it has been advised to puncture the pelvic abscess *per rectum*, but this plan is to be deprecated, as a permanent fistula may result. The vagina is the natural route for the evacuation of all intrapelvic collections of pus. Having located the abscess by palpation, the needle is introduced along the finger with the patient in the dorsal posture and is steadily pushed into the sac. On the appearance of a drop of pus, without removing the needle a pair of sharp-pointed scissors, closed, is passed along beside it, and is gradually made to work its way into the sac. The blades are then separated and withdrawn. A dilator may then be introduced and separated so as to make a free opening; the fingers are inserted, the sac is thoroughly explored, and granulations and bands of tissue are broken down. The cavity is irrigated with a weak bichloride solution, then with peroxide of hydrogen, and again with boiled water. The cavity is packed with gauze, which is left *in situ* for two or three days, after which it is removed and the cavity irrigated two or three times daily. This treatment is especially applicable to abscesses of the tube or ovary in which for any reason it is undesirable to perform a radical operation. In the case of large pelvic abscesses drainage with a T-shaped rubber tube is preferable to gauze.

The technique of vaginal operations for hæmatocele and ruptured ectopic gestation, suppurating ovarian, and dermoid cysts, etc. is practically the same as above, the object being to thoroughly evacuate the contents of the sac and to promote subsequent granulation and adhesions of its walls.

The method of dealing with abscesses of the tubes and ovaries and of performing vaginal oöphorectomy is described more fully elsewhere.

SYMPHYSIOTOMY.

By WILLIAM T. LUSK, M. D.

THE doctrine[1] of the separation of the *pelvic* bones due to softening at the articulations during pregnancy, and especially at the time of labor, was taught by Hippocrates and Avicenna. Galen maintained that the pelvic symphyses were true joints. Vesalius, on the other hand, insisted that the bones of the pelvis were united by ordinary cartilage. The prestige of Vesalius as an anatomist exerted a great influence upon the opinions of his contemporaries. When, in 1519, Jacques Amboise invited the most eminent physicians and surgeons of Paris to be present at the dissection of a woman executed for child-murder a few days after the birth of the child had taken place, few responded, and yet on this occasion he demonstrated that a separation of the pelvic bones existed, and that it was not a pathological condition. Pinæus, who was present, was greatly interested, and took notes of the lecture, the leading points of which he reproduced in a brochure published in 1575. In this Pinæus stated that of the pelvic joints the symphysis was most affected. The synchondrosis, he said, was like a sponge, which swelled during pregnancy, and became dry subsequently. The resulting softening was due to a physiological succulence caused by pregnancy. He recommended the employment of cataplasms, of inunctions, and of hip-baths as means to enhance the normal process. To aid him in winning converts to his doctrine he associated with him the eminent physician Rivière, who had likewise studied the physiological changes at the joints due to pregnancy. If, said Rivière, one flexes during labor both thighs upon the abdomen, and at the same time everts them, the fœtus descends with each pain, owing to the separation at the symphysis. Pinæus went farther, and said one might even divide the symphysis to facilitate difficult labor, and quoted Galen to the effect that the contents are of more value than the receptacle, and that one ought to stretch, or even incise, the latter in the interest of the former. There is no doubt, says Pinæus, that in this instance the fœtus is of the greater importance.

Among the eminent authorities whom we find later enlisted on the side of the doctrine that the pelvic dimensions are increased as a consequence of pregnancy and labor may be mentioned Sylvius, Fernel, Deleurye, Riolanus, and Morgagni.

As a fruit of these studies symphysiotomy was performed as a substitute for the Cæsarean section with the view of saving the child by Jean Claude de la Courvée at Warsaw in 1585, and by Plenck in Germany in 1766, upon women who had died during labor.

[1] For these historical details I am indebted to the recent work of Franz Ludwig Neugebauer, *Ueber die Rehabilitation der Schamfugentrennung*, Leipzig, 1893.

But as a means to facilitate labor on the living subject in cases of contracted pelvis the first definite proposition came from Jean Réné Sigault in 1768, while he was a student of medicine in Paris.

The first actual operation, it is now claimed, was performed by Domenico Ferrara in 1774, in the Hospital for Incurables in Naples. Ferrara had studied in Paris and had heard of Sigault's proposition in 1768. The case ended fatally, but it possesses a special interest because it was in the same hospital that a century later Morisani had the honor of restoring the discredited procedure to a recognized place in the practice of obstetrics.

The suggestion to employ symphysiotomy was at the time received by the Paris Academy of Medicine with scant favor, but in 1777 Sigault had an opportunity to subject his theoretical views to a practical test. The patient, Mme. Souchot, the wife of a soldier, was three feet eight inches high and thirty-nine years old. The pelvic conjugate was estimated at $2\frac{1}{2}$ inches. She had previously been confined four times; all the children were born dead. In the third pregnancy labor was induced at the eighth month, but the birth was very difficult, and was followed by prolapse of the vagina. In the fourth pregnancy (1775) Sigault, despairing of obtaining a living child, wished to try symphysiotomy, but the proposal was declined. The fifth pregnancy occurred in 1777. Labor began on the 30th of September The head presented. Meantime the patient had given personal thought to her case. She was most anxious for a living child. She had heard of an operation performed experimentally, with a favorable result, upon a parturient sow by Camper, one of the greatest authorities of his day. She decided therefore to submit herself to the novel experiment. She even picked the necessary lint, and cheered her despairing husband with the hope of a living child.

The operation was performed on the night of October 2d by the light of a lamp held by a maid, and with the assistance of Alphonse Leroy, the future historian of the event. Sigault divided the symphysis with an ordinary bistoury. He then ruptured the membranes, and, aided by Leroy, extracted a living child by the feet. The separation at the symphysis during delivery was $2\frac{1}{2}$ inches, and after the birth was 8 lines. The hemorrhage was trifling. The wound was dressed with lint, and a bandage was applied to the pelvis. The patient had no fever and nursed her child. On the fourth day the bandage was removed, as it distressed her; the bowels moved on the seventh day; there was at first incontinence of urine from injury to the urethra, but this gradually disappeared. On the fourteenth day Mme. Souchot moved without assistance from one bed to another; on the twenty-fifth day she sat up in bed, and on the forty-sixth day she went, unaided, but wearing a bandage, down four flights of stairs to the street and to church. Afterward she walked, resting on her husband's arm, up the steps to the lecture-room of the Faculty of Medicine, and was examined by a number of the professors.

The operation naturally caused an extraordinary sensation. The Faculty of Medicine awarded to Sigault a silver medal.[1] Enthusiastic ovations were prepared in his honor, and he was regarded as a bene-

[1] "Pour récompenser l'inventeur d'une découverte si utile à l'humanité, on ferait graver une médaille en son honneur comme témoignage de reconnaissance et d'admiration."

factor of the human race. But the triumph was of short duration. The French Academy of Surgery under the lead of Baudelocque opposed to the new measure a most determined hostility. The ensuing cases were not all equally successful. It is not now easy to determine, amid the conflicting statements that have come down to us, the exact truth as to the issue of those early operations.

Siebold was successful in saving the mother in 1778. Sigault operated six times, with the loss of one mother and five children. Leroy in four operations lost one mother and one child. De Cambon in four cases lost one mother and two children. It must be remembered that at the time mentioned Cæsarean section, the rival procedure, was in Paris and Vienna[1] nearly uniformly fatal. The heavy mortality among the children was probably not directly connected with the operation, but was due in most cases to the conditions which furnished the indications for the operation or to delays in its performance.

But it was not so much the statistical results about which the early combatants were concerned. The supporters of the Cæsarean section maintained that in the cases in which symphysiotomy was advocated as a substitute for the older measure the increase of space obtained by division of the symphysis was not sufficient to permit the extraction of the living child, except with the infliction of dangerous injuries to the sacro-iliac articulations. In proof of this Baudelocque demonstrated upon the cadaver of a rhachitic dwarf that, in spite of symphysiotomy, he was unable to procure the descent of the head into the pelvis, even with powerful traction by the forceps. When, finally, he succeeded by the employment of force exerted from above, combined with lateral pressure applied to the child's head, rupture of the pelvic joints followed. In the fatal cases referred to which occurred in the practice of Leroy, of Sigault, and of Cambon it was found at the post-mortem examination that the posterior articulations had ruptured and were filled with pus. However, in each of these four cases the conjugata vera was less than $2\frac{1}{2}$ inches—a degree of pelvic contraction which recent symphysiotomists regard as contraindicating the operation, at least at the end of gestation.

As the outcome of his experiments Baudelocque concluded that symphysiotomy was admissible only in cases where the conjugata vera was not less than $2\frac{3}{4}$ inches, and that the divergence of the pubic bone should not be allowed to exceed 1 inch.[2]

In the cases of apparent success Baudelocque alleged that the operation was unnecessary, and that Nature or the forceps would alone have sufficed to achieve the desired result. It was of course natural that in those tentative days the after-effects of pubic section did not always correspond to the expectations of its advocates. While the extent of the consecutive injuries was doubtless exaggerated for partisan purposes, the histories reported sufficed to throw further discredit upon what was theoretically pronounced a questionable procedure.

[1] Baudon in 1873 wrote that there had not been a successful case in Paris in eighty years. Spaeth, before the appearance of Sänger's well-known work, found, in looking over the records, that there had been no recovery from the operation in the Vienna lying-in hospital during the present century.

[2] *Vide* "Die Symphyseotomie und ihre wissenschaftliche Begründung," von Dr. Wehle, *Arbeiten aus der Königlichen Frauenklinik im Dresden*, 1893, S. 3 and 9.

The outcome of the controversy was so complete a victory for the Cæsarean school that in France, England, Germany, and America most writers on obstetrics either omitted all mention of symphysiotomy, or referred to it either as a subject for invective or as a matter of historical interest.

In Italy alone symphysiotomy never fell into complete disfavor, but was always recognized as an admissible measure in the treatment of contracted pelves. In the table of Neugebauer, compiled from the statistics of Morisani, of Harris, and of Desforges, of the 136 cases known to have been operated upon between the years 1776 and 1866, 56, or about two-fifths of the entire number, occurred in Italy. Between the years 1815 and 1841, Galbiati operated 18 times. The results in Italy were indeed not particularly satisfactory. Thus in the 56 cases 22 mothers were known to have recovered, 18 were reported to have died, and in 16 the issue was in doubt; 16 of the children were born alive, 22 died, and in 18 cases the result was uncertain.

In 1863, Morisani[1] of Naples published a memoir on the pelvic contractions and the indications they afford at the time of birth, in which he endeavored to determine by experiments on the cadaver the mechanism of the increase of the diameters of the superior strait after symphysiotomy, and the average increase obtained. As a result of these investigations he was convinced that, in spite of the classical objections to the operation, the gain in the pelvic space was real, and that, within certain limits, to be determined by clinical experience, the operation was reasonably devoid of risk.

Between July 25, 1858, and February 4, 1865, Harris tells us there was no known case in which symphysiotomy was employed. At the latter date Prof. Bellozi of Bologna operated, but the patient suffered from tuberculosis, and died twelve days afterward from pneumonia. On the 5th of January, 1866, Morisani performed his first operation. Both mother and child were saved. This success marked the beginning of a new era.

At the meeting of the International Medical Congress in London in 1881, Morisani was able to publish 50 operations that had been performed in Naples between 1866 and that date, with the saving of the lives of 41 mothers and 41 children. It seems strange now to recall the slight impression these results then made, and yet they were all the more remarkable as at the time of this report aseptic methods were sparingly practised. In the same year Novi,[2] whose name stands hardly second to that of Morisani in the history of the revival of symphysiotomy, published an important memoir on the same subject of a statistical and clinical nature. In 1883, Mangialli[3] in Italy and our own Harris[4] in two memorable papers strove to further awaken general interest in what they regarded as a coming revolution. Again, in 1886, Morisani made a report of the cases that had been operated upon in Naples between 1881

[1] *Vide* Caruso, "Contributo alla pratica della sinfisiotomia," *Annali di Ostetricia e Ginecologia*, April, 1892 (foot-note No. x.).

[2] Novi, *La Sinfisiotomia refugiata presso la Scuola Napoletana*, Napoli, 1881.

[3] Mangialli, "Una probabile resurrezione nel campo dell' ostetricia operativa," *Annali di Ostetricia*, ecc., 1883, p. 6 (*vide* Caruso).

[4] Robt. P. Harris A. M., M. D., "The Revival of Symphysiotomy in Italy," *The Am. Journ. of the Med. Sciences*, Jan., 1883.

and that date. They were 18 in number. The results were unfavorable: 8 of the mothers were lost; 5 of the children were born dead. The contrast between this lamentable outcome and the brilliant contemporaneous record of the Cæsarean section was too striking. Outside of Italy the battle was regarded as lost.

In the month of October, 1891, Spinelli went, at the suggestion of Morisani, to Paris to place before the medical profession of France the most recent achievements of the Neapolitan school in symphysiotomy. Between 1888 and 1891 he was able to report a succession of 24 cases, with the recovery of 24 mothers and the saving of 23 children's lives. In a lecture[1] delivered before the assembled Paris accoucheurs he demonstrated the operation upon the cadaver. He taught that, thanks to symphysiotomy, a full-term child can be extracted in a pelvis measuring not less than 2½ inches (65 mm.), and that with proper antiseptic precautions, and within the limits indicated, the operation is devoid of danger.

Among the first to accept the new doctrine was Pinard,[2] who on the 7th of December, 1891, delivered at the Baudelocque Maison d'Accouchements a lecture in which he earnestly and eloquently defended symphysiotomy. By means of the pelvic section he furnished a most striking illustration of the reality of the pelvic increase consequent upon the division of the symphysis, and at the same time he expressed his conviction that the operation was not, as the rule, difficult of execution, and that it could be performed without injuring the bladder or the peritoneum. On the 4th of February, 1892, he performed his first operation, which ended favorably both for the mother and the child.

In March, 1892, Charpentier, after a personal visit to Naples, furnished to the French Academy of Medicine an admirable digest of the subject which had a widespread circulation. In April, Caruso[3] contributed an important paper containing the recent Neapolitan statistics, and giving practical details concerning the indications, the methods of operation, and the care of patients after the operation. He declared that with antiseptic precautions there should be no mortality from section of the symphysis, and that in the case of a fatal result the death should be attributed to the operator rather than to the operation.

Finally, general interest was awakened in the subject in America by Harris's[4] article, read before the Gynecological Society in October, 1891, and through the publication of a successful case by Prof. Jewett[5] of Brooklyn.

Anatomy.—To operate intelligently and with reasonable assurance of success a knowledge of the anatomy involved becomes a matter of prime importance. Fortunately, following the visit of Spinelli to

[1] Spinelli, "Les resultats de la Symphyseotomie antiseptique à l'École obstetricale de Naples," *Annales de Gynécologie*, Paris, Janvier, 1892.

[2] Pinard, *De la Symphyseotomie.*

[3] F. Caruso, "Contributo alla pratica della sinfisiotomia," *Annali di Ostetricia e Ginecologia.*

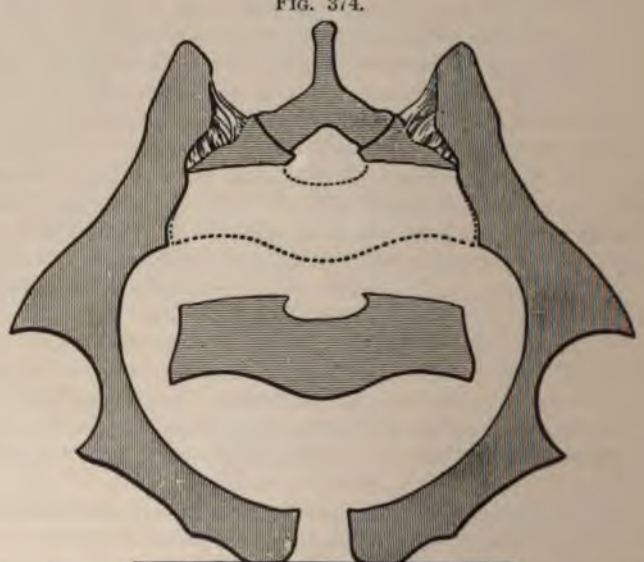
[4] Harris, "The Remarkable Results of Antiseptic Symphysiotomy," *Gynecological Trans.*, 1892.

[5] To Prof. Jewett belongs the honor of contributing the first published case of symphysiotomy in America. His bore date of Sept. 30, 1892, but the first actual case in the United States, according to Dr. Harris, was one operated upon by Dr. Joel O. Williams of Denison, Texas, in 1880. Both mother and child are still living.

France, Farabœuf, who became greatly interested in the rehabilitation of Sigault's work, entered enthusiastically upon the labor of supplementing the defective and vague teachings of the ordinary text-books by clear and definite description of the structures involved. The beautiful studies of the eminent Paris professor were at once made by Pinard and Varnier the foundation of their practice in the Hôpital Baudelocque. The remarkable triumphs which ensued are the incentives which prompt me even at some length to place them at the disposition of the English-reading medical public.[1]

One of the first results of substituting observation for deductive reasoning was to demonstrate that Matthews Duncan was incorrect in maintaining that the sacral articulation slopes backward and inward in the direction of the median line, and that the fact that the sacrum does not under pressure drop from the arch is due to the sacro-sciatic ligaments which hold it in position as part of the bony ring. On the contrary, a series of sections through the sacro-iliac articulations at different points, made parallel to the pelvic brim, sufficed to demonstrate that the shape of the sacral articular surface is such that the sacrum, in its insertion between the ilia, in reality forms a key-stone to the pelvic arch (Fig. 374). In a striking experiment Farabœuf has shown that if a

FIG. 374.

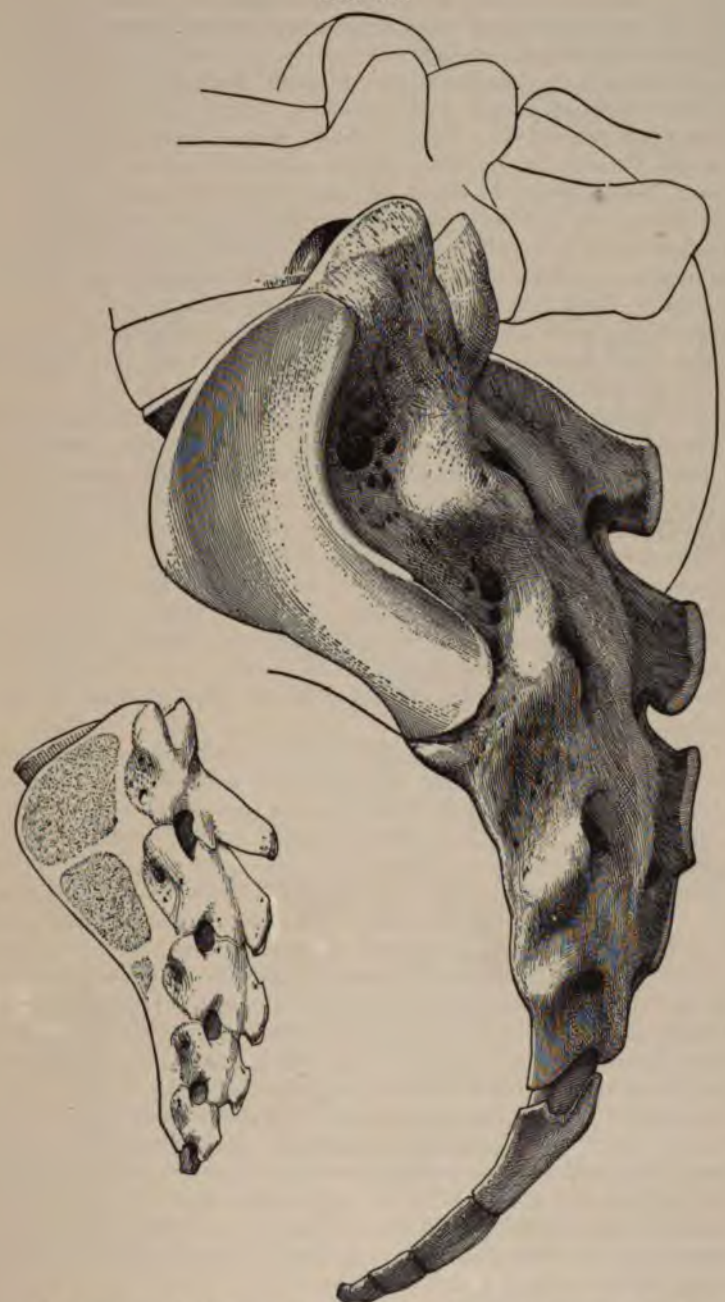


Transverse pelvic section near the superior strait, pubic bones separated by a finger's brea experiment of Farabœuf, showing that the sacrum actually forms a key to the pelvic arch, is not simply held in place by the ligaments. If a longitudinal section be made through sacrum in front of the ligaments, the resected portion remains solidly *in situ* until a consi able degree of pubic separation has been effected.

frontal section of the sacrum be made from above downward and front of the ligamentous attachments, the anterior segment, so long as t

[1] The privilege to use the accompanying illustrations, which have been to me i valuable in studying the operation of symphysiotomy, I owe to the courtesy of Pr Farabœuf.

FIG. 375.



Side view of the sacrum of an adult and of that of a young child. In the latter the costal portions which are to form the auricle are imbedded in the cartilage.

pelvic ring is closed, is held tightly in place by the iliac pressure alone.

The loss of the support due to this pressure must be borne in mind after division of the symphysis and in cases where, after symphysiotomy, the pubic union remains incomplete.

The ligaments by which the fastening of the pelvic bones is secured posteriorly are short, strong, and inelastic. They run for the most part in a transverse direction. Passing from above downward, the first in order is the ilio-lumbar, which extends from the transverse process of the lower lumbar vertebra outward and backward and is inserted into the iliac crest. It fulfils the function of hindering the disposition of the last lumbar vertebra to glide forward over the inclined plane of the base of the sacrum. The most important bands traverse the sacro-iliac articulation. They are arranged in three groups:

First. A ligament passes from the transverse process of the sacrum across the upper border of the auricular surface to the tuberosity of the ilium, not far from the iliac crest.

Second. Below the above the sacral surface offers a number of tuberosities formed, during the developmental period, by the fusion of the sacral transverse processes and by the junction of the sacral vertebræ. Each process separates into an ascending and descending branch, which unites with corresponding branches above and below to circumscribe the sacral foramina. The tuberosity thus formed at the linea transversa between the first and second sacral vertebræ is situated at a point near the middle of the auricular surface. It looks upward, outward, and backward, and furnishes attachments to a great number of bands (the ligamentum vagum), varying in size, in thickness, and in direction, which are distributed to a pyramidal eminence on the inner surface of the iliac tuberosity.

Third. The tuberosity between the second and third vertebræ corresponds to the lower border of the auricular surface. It looks toward the internal surface of the posterior superior spinous process, to which it is attached by a short, thick ligament named by Farabœuf the ligament of Zaglass.

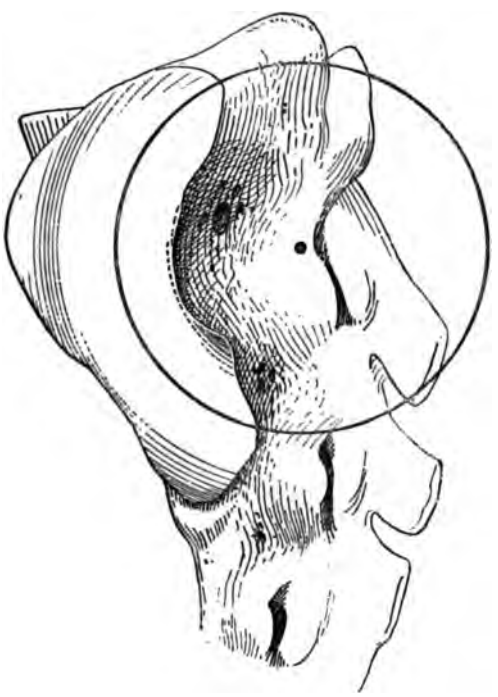
Each auricular surface forms the arc of a circle hollowed upon the sacral and in relief upon the iliac side. The smooth surfaces of the articulations covered with cartilage permit a restricted movement of rotation (Fig. 375). The centre around which this movement takes place is situated in the vicinity of the first sacral tuberosity, the ligaments at which point have, in consequence, sometimes been termed "axillary," but the irregular distribution of the ligamental bands has led Farabœuf to compare the ilium to a button badly sewed to the sacrum.

The extreme degree of forward rotation of the promontory is produ in a person slightly bent and carrying a heavy weight upon the should In an acrobat balanced upon a trapeze, with the cross-bar beneath loins, with the lower limbs hanging downward, and with the trunk a ing upon the sacrum, the promontory is moved backward and the cocc is rotated forward. In the former instance a narrowing, in the latte widening, of the conjugata follows.

Clinically, similar conditions may be produced in the recumbent p ture by acting upon the ilia (the long arms of the lever). Thus, by fle ing the thighs so as to touch the chest the ilia are rotated upward and t conjugate is shortened, or by placing the patient with the hips at the edg

of the bed or table, and with the thighs hanging downward (Walcher's position), the ilia are made to move in an opposite direction. As the pubis rotates in the direction of the coccyx the antero-posterior diameter of the brim is lengthened, with a corresponding diminution in that

FIG. 376.



The hollow of the auricular cavity is seen to follow in a circle, the centre of which is situated at the first tuberculum conjugatum, and is indicated in black. In fresh specimens many fibrous bundles pass from the tuberosity of the ilium to the joint, forming the ligamentum vagina or axillary ligament.

of the excavation and of the outlet. The displacement communicated to the pubic end of the lever by these methods amounts to very nearly an inch, while that at the sacro-iliac joint barely equals one-fourth of that amount.[1] The actual gain to be derived from position, therefore, Farabœuf regards as insignificant, and yet when dealing with the contracted pelvis previous to engagement the smallest increase at the superior strait is deemed precious by the bedside attendant.

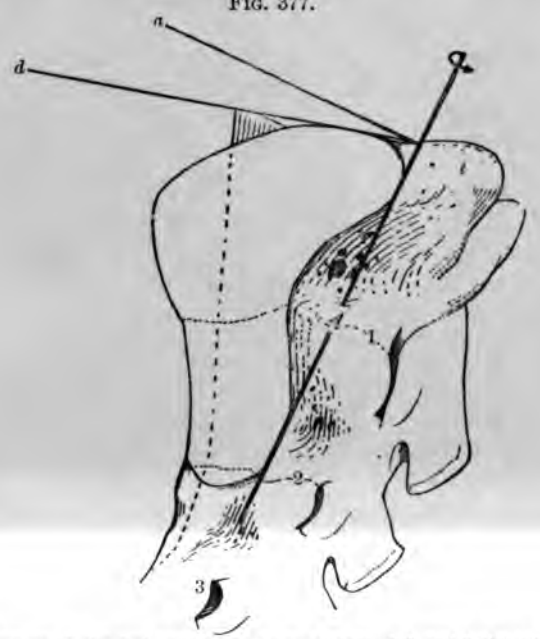
After section of the symphyses each lateral wall of the pelvic excavation turns outward, as upon a hinge, around the sacrum. The axis of this movement descends obliquely downward (Fig. 377) and somewhat inward in a line touching the upper and lower cornua of the auricular surfaces. The posterior ilio-transverse ligaments as a whole are not affected by the separation of the pubic bone. Only a few fibres of the ligamentum vagum situated in front of the axis are put upon the stretch,

[1] The movement at the pubis Farabœuf estimates approximately at 20 millimetres, and that at the sacro-iliac point at about 5 millimetres.

and the exercise of a little force may be required to complete their rupture.

The fibres of the periosteum which constitute the anterior sacro-iliac ligaments are the first to feel the effect of the disjunction at the pubis, especially those fibres which are farthest removed from the axis—*i. e.* from the cornua of the auricular surfaces: the separation begins, therefore, at the linea innominata, and thence passes a short distance outward.[1]

FIG. 377.



Lateral view of sacrum: 1, the first sacral transverse process; 1, 2, and 3, the tubercula conjugata. The line *A* represents the axis about which the ilium turns after symphysiotomy. The line *d* represents the plane of the superior strait.

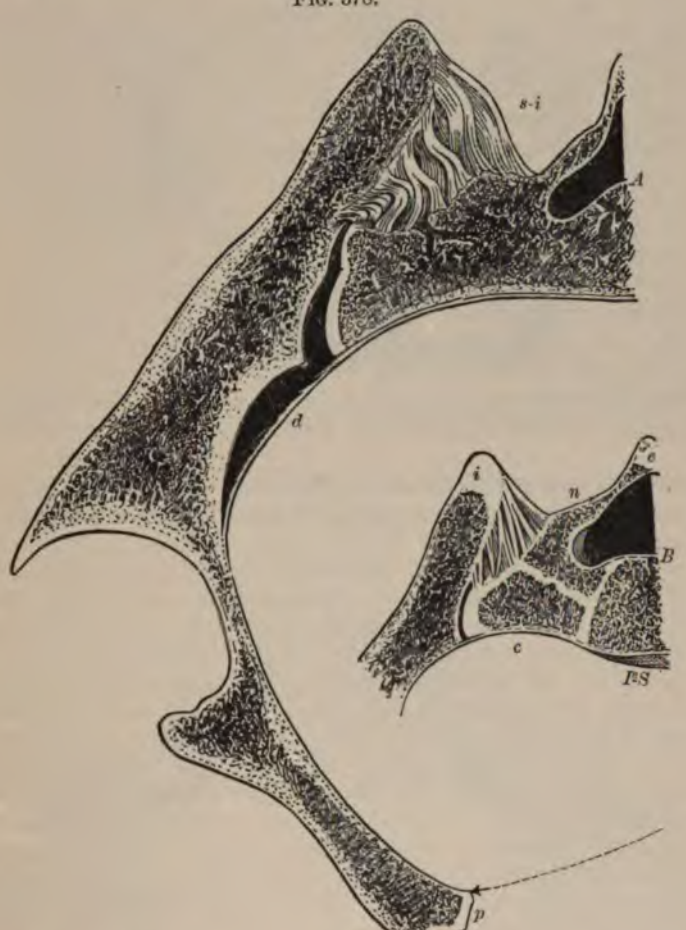
It is confined to the ilia alone. Above and below it is limited to the vicinity of the extremities of the articulation (Fig. 378). The stripping up of the periosteum may, however, be increased if at the beginning of rotation a tuberosity of the ilium upon either side comes into contact with a bony projection upon the sacrum.

Experience shows that the pubic bones as they separate follow very nearly the plane of the superior strait. The sacro-pubic distance is increased until a point opposite the sacro-iliac joint is reached. As the axis of this rotation has an oblique direction, a marked descent of the pubic extremities results. To use a familiar illustration of Farabœuf, the movement is like that of the door of a street lamp upon hinges attached to a sloping side. An asymmetrical separation at the sacro-iliac articulations is indicated when the lateral halves of the pelvis occupy different planes. An exaggerated difference of level in the pubic bones, at times amounting to an inch and a half, may be produced by forcibly flexing one limb while the other remains extended.

[1] "A few centimetres" (Farabœuf).

The weight of the flexed thighs in abduction suffices ordinarily to so far overcome the resistance offered by the sacro-iliac fastenings as to permit a separation of an inch at the pubis. Beyond that point a certain amount of force may be requisite to strip up the periosteum and to rupture the fibres of the ligamentum vagum, which are situated in front of the axis of iliac rotation. If by mischance the outward pressure applied

FIG. 378.



Separation of the pubis after symphysiotomy of 2½ inches; detachment of the periosteum from the ilium at *d* equals on the average 1½ inches: *s. i.* relaxation of the sacro-iliac ligaments; *B*, transverse section through the first sacral vertebra of an infant three months old; *n*, neural portion; *c*, costal portion.

to the knees, by means of which the sacro-iliac separation is produced, acts unequally upon the two sides, further separation upon the side where it is already sufficient may be arrested by forcible adduction and flexion of the thigh (Fig. 379). This manœuvre reapplies the ilium to the sacrum, and enables the operator to employ forcible abduction upon the other knee until a symmetrical separation has been attained.

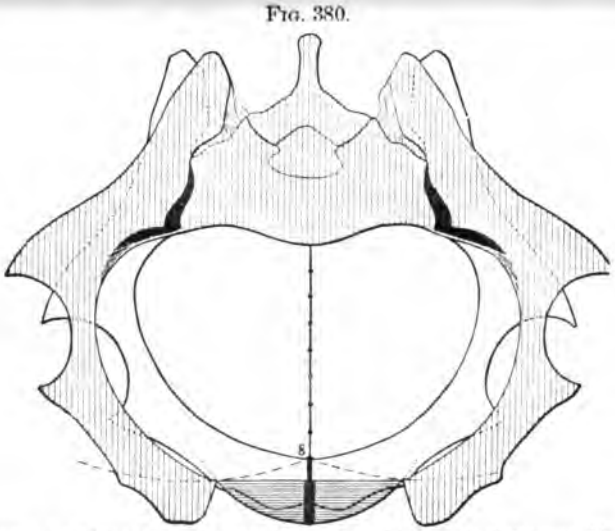
The advantages to be won from symphysiotomy are derived from three sources:

FIG. 379.

With the right thigh held forcibly in flexion and abduction, the right ilium is made fast to the sacrum. By the abduction of the left leg the disjunction of left sacro-iliac articulation is then accomplished.

First. The increase of the sacro-pubic distance. In a pelvis measuring $2\frac{1}{2}$ inches in the conjugate the gain, according to the measurements

FIG. 380.



Symmetric separation after symphysiotomy. The sacro-pubic distance is increased by the outward rotation of the iliac. The chief gain is due, however, to the projection of the parietal boss between the pubic bones. When the separation of the latter equals $2\frac{3}{4}$ inches, the available utero-posterior space is augmented by more than an inch.

of Faraboeuf, when the separation of the pubic bones (Fig. 380) amounts to $2\frac{1}{4}$ to $2\frac{3}{4}$ inches, is very nearly a half inch.

Second. In the engagement and descent of the head a segment of the latter occupies the space between the separated pubic bones. The resultant gain is dependent upon the width of the gap and the convexity of the child's head. Farabœuf estimates this roughly, with the anterior parietal boss occupying an interval measuring from 2 to 2¼ inches, at three-quarters of an inch.

The advantage from these two sources therefore should be placed at very nearly an inch and a quarter.[1]

Third. The forced extension of the thighs adds a few lines to the superior strait, but this addition is at the expense of the pelvic cavity. In estimating the justifiability of symphysiotomy therefore it is necessary for this reason to take into account not only the size of the conjugate, but the curve of the sacrum, and the distance between intermediate points situated upon the inner surface of the pubis and of the sacrum.

In the ordinary flattened pelvis after section the spontaneous separation of a few lines which ensues is followed by the descent of the posterior frontal bone and ear, due to the sinking of the pubis, upon which the anterior frontal bone rests. With forced separation the latter sinks to the level of the boss, and the posterior ear descends beneath the promontory, to which the posterior frontal bone is applied. Engagement is then accomplished by the rotation of the head around the promontory, by means of which the entrance of the anterior cranial surface into the pelvic cavity is effected. But this mechanism is dependent upon a sufficiency of the sacral curve.[2]

It is important, furthermore, to remember that in cases where the adjustment of the head to the pelvic space is close the entrance of the head at the brim may be facilitated by the backward rotation of the promontory produced by the extension of the thighs. On the other hand, when the engagement is interfered with by the contact of the posterior parietal surface with the sacrum, a utilizable gain in the median pelvic diameter may be realized by the movement of counter-rotation produced by flexing the thighs and lifting the extremities of the pubic bones.

Finally, it should be remembered that the increase of space resulting from symphysiotomy is not confined to the antero-posterior diameter, but extends to all the dimensions of the pelvis.

The Symphysis.—The bones of the pubis are connected by a plug composed of pure cartilage where it comes in contact with the surfaces of the bones, and of fibro-cartilage toward its centre. Both the intervening plug and the ends of the bones are enveloped in a periosteal covering, reinforced by tendinous attachments from the adjacent muscles.

During early life the pubic bones at the symphysis are convex. The cartilage which serves for their growth and nourishment is thick and hyaline. After puberty, however, there forms in the cartilage at a point which is destined later to become the angle of the pubis a bony process which gradually extends to the upper border of the pubic body, to its anterior surface, and to the surface of the symphysis itself.

[1] In minor degrees of pelvic contraction the relative advantage is slightly lessened.

[2] Farabœuf estimates that in a pelvis measuring 2½ inches (60 millimetres) antero-posteriorly the extraction of the child after symphysiotomy becomes extremely difficult, where the median pelvic diameter is not three- to four-fifths of an inch (15 to 20 millimetres) longer than at the brim.

As a consequence of the tardy growth of this process it is practicable, in a parturient woman under twenty, to make an incision either directly in the median line or a third of an inch to the side of the median line in the hyaline cartilage, which still separates the rounded epiphysis from the pubic border. At a later period, after the union of the epiphysis

FIG. 381.

Showing the fusion of the ligamentum arcuatum and the fibrous covering.

FIG. 382.

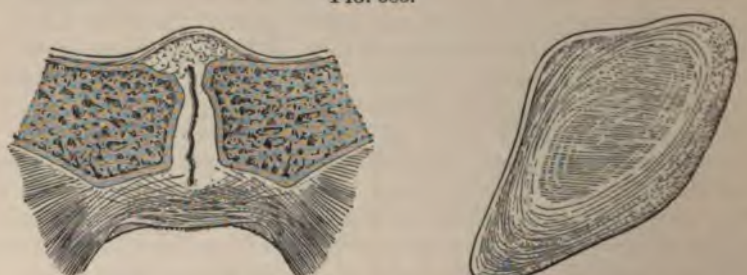
The section is made a little below the upper border and displays the bony epiphysis on each side.

and the body is completed, the bony surfaces are no longer rounded, but are uneven and traversed by grooves and ridges. These, though the intervening space is in reality ample, have a tendency to catch the knife of the unwary operator, and thus to give rise to fables regarding the bony ankylosis of the symphysis during the childbearing period.

The solidity of the pelvis is due not so much to the fibro-cartilage at the pubic articulation as to the glistening pearly fibres by which the cartilage is enveloped and reinforced.

Upon the posterior surface the prominence which marks the line of bony union between the pubic bones is covered by the periosteum. This latter, at the upper portion of the symphysis behind the recti

FIG. 383.



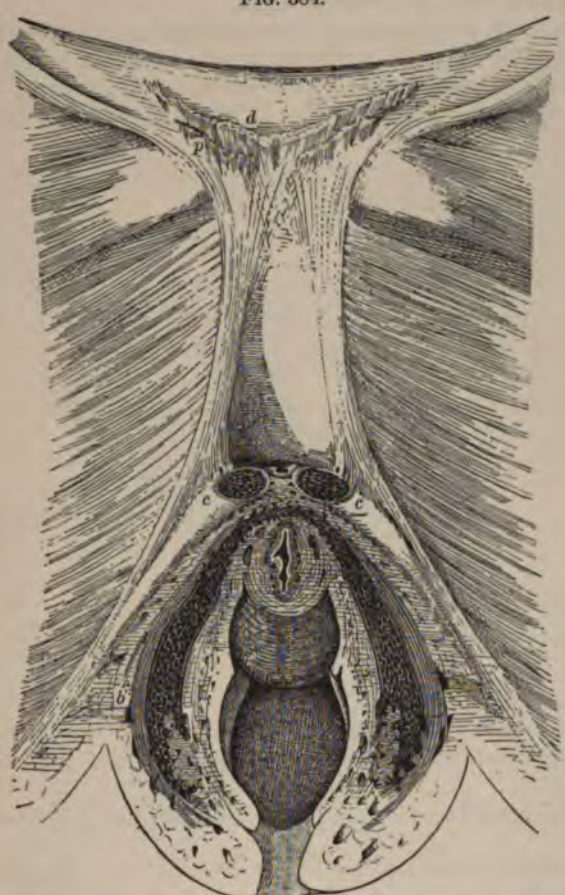
Median, sagittal, and transverse horizontal sections through the symphysis of a young woman. The posterior ridge is short, but the periosteum is literally packed with bundles of fibro-cartilage, pursuing for the most part a horizontal direction.

muscles, is strengthened by the access of fibres from distant sources, as, for instance, from those which border the pubic crests. Below, beneath the pubic arch, it forms the ligamentum arcuatum. Anteriorly the symphysis is increased in thickness by the accession of a vast number of tendinous elements which intercross at the median line.

When an incision is made through the adipose tissue of the mons Veneris, and the divided surfaces are drawn well apart, the operator

exposes laterally the attachments of the muscles of the thigh to th ridges which border the symphyseal space. Overlying these a longitudinal bands derived, for the most part, from the external of the inguinal ring. Above, the internal pillars cross at the r line and are attached each to the bony ridge upon the opposite Below, at a variable distance from the arch, the filaments which

FIG. 384.



Transverse section of the external genital organs of the woman close to the lower anterior surface of the pubes and symphysis: *d*, insertions of the recti muscles; *p*, insertion of pyramidalis. The clitoris and its suspensory ligament have been cut away; the fossa, and the longitudinal ligaments are exposed; the rami of the clitoris are cut across, and the opening beneath the symphysis is brought into view.

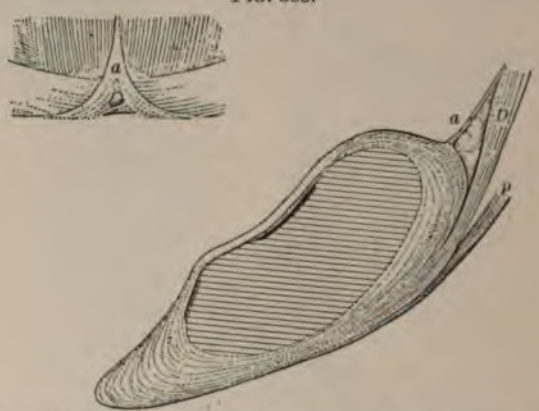
the suspensory ligaments of the clitoris are brought into view. Between the longitudinal bands a grooved depression, which attains its maximum width and depth on a line with the arch, may be felt by the finger.

The flattened tendon of each rectus muscle is attached to the anterior surface of the pubis below the upper border. This distance is greatest at the median line, where it may reach a half inch or more. The tendon is covered by the pyramidal muscle. The external half is flat, and is

attached in front of the upper border of the pubis upon its own side. The inner half passes downward for a somewhat greater distance without fusing with the fascial covering of the symphysis. It then begins wholly or in part to adhere and to intercross with the tendon of the opposite side. At a lower point its fibres separate and become interwoven with the transverse fibres of the underlying tendinous structures, and finally descend to form insertions *en echelon* into the bony ridge opposite the side from which they had their origin.

When the recti are separated there is often found beneath a little fat a small triangular body, the adminiculum, attached by its base to the upper border of the symphysis and of the pubic bones. Its apex is confounded with the linea alba. It receives fasciculi from the recti

FIG. 385.



Median section through the fibro-cartilaginous plug between the pubic bones. The fibro-tendinous covering is thin behind, where two subjacent synovial cavities may be noticed—thick above at the attachment of the adminiculum (*a*) and in front at the insertion of the recti (*D*) and pyramidal (*p*) muscles; very thick below where it forms the ligamentum arcuatum.

muscles, to which it serves as a tendon. Its base is riddled by small perforating vessels. This small body may furnish a certain amount of resistance when an attempt is made to pass the finger behind the symphysis.

After section of the mons Veneris the operator has therefore to cut through—

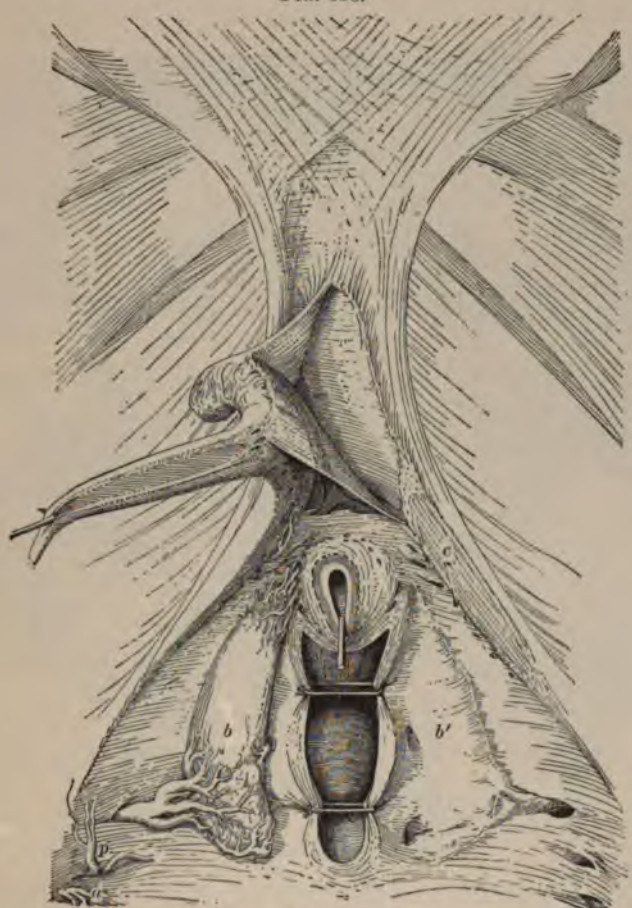
1st. The fibro-tendinous coating (perichondrium), anteriorly thick and complex in structure, posteriorly composed of periosteum alone. The latter is thick in its upper portion. It can be reached only by dividing the space between the recti muscles and the linea alba and after breaking through the adminiculum.

2d. The fibro-cartilaginous plug, thick above and below and in front, where it is, for the most part, confounded with the perichondrium; behind, it is narrowed by the approximation of the pubic bones.

The Relations of the Symphysis to the Adjacent Pelvic Organs.—It will be remembered that in ordinary labor the head, in its transit through the parturient canal, stretches the levator and pushes back the coccyx, and, as it passes through the vulvo-vaginal outlet, forcibly dilates the ischiatic layers of the perineal fascia. But after symphysiotomy the

head moves forward to profit by the gap in the bony ring. A strain is thereby placed upon the anterior vaginal wall, which, unless met by some counter-support, may endanger its integrity. Below, at the vulva, the separation of the bones is limited somewhat by the crura of the clitoris, by the fascia in front of the urethra, and perhaps by the pubic attachments of the bladder. When the tension to which these structures

FIG. 386.



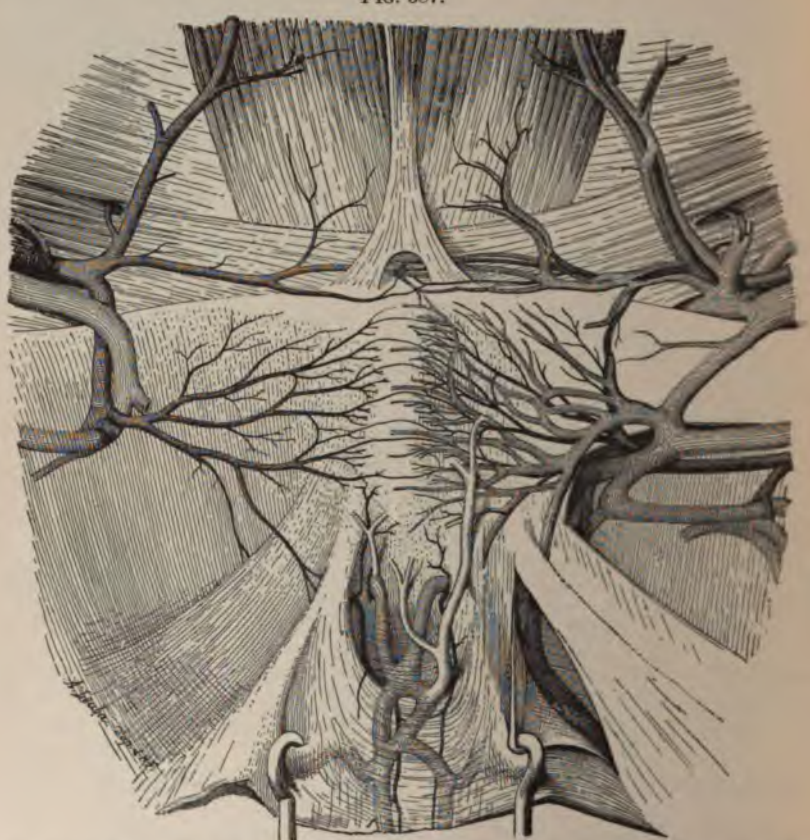
Deep portions of the vulvar region—symphysis, clitoris, bulb, lower layer of the perineal fascia. The left ramus of the clitoris has been detached from the arch and carried to the right. The left bulb has been removed. The excision of the left half of the suspensory ligament brings into view, beneath the arch, the cellular layer in which are located the veins of the neck of the bladder, of the urethra, and of the clitoris.

are exposed becomes excessive, they are liable to give way, and an extensive laceration of the vagina to the side of the urethra may ensue. For this reason a careful watch should be kept upon the space between the pubic bones, and, either by the hands of assistants or by instrumental means, the gap should not be allowed to exceed the narrowest limits rendered necessary for the passage of the child.

The crura of the clitoris are solidly attached to the inner surfaces of

the ischio-pubic rami, and are adherent to the lower layer of the pelvic floor, across which are distributed the terminal branches of the pudic artery—viz. the arteries of the corpora cavernosa, the urethral artery, and the dorsal of the clitoris, all vessels of insignificant size. The cavernous tissues are enveloped in a fibrous sheath which is reduced to a minimal thickness at the long and narrow point of contact between the crura and the pubic arch, where, indeed, the albuginea is apparently replaced

FIG. 387.



The vessels upon the pelvic surface of the symphysis: on the left side the arteries alone have been preserved; on the right side both veins and arteries are visible. The bladder is drawn downward by two hooks, putting the pubo-vesical ligaments on the stretch on each side of the median fossa, into which penetrate the two anterior vesical arteries, branches of the pudic artery.

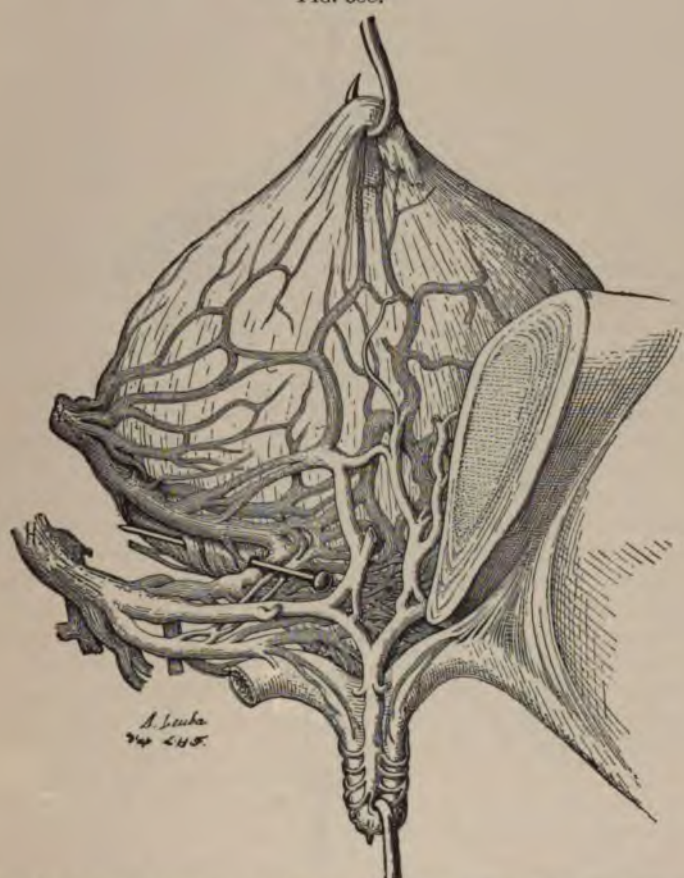
by the periosteum. The adhesions of the fibrous sheaths to the pe[rios]teum are very firm, and extend upward to a variable extent along [t]ridges which serve as the points of insertion to the adductor mu[s]. In the fossa between the ridges the clitoris is free. The crura as[c] and unite to form the body at a variable height, sometimes on a l[e]with the arch, sometimes above the middle of the symphysis.

When an incision is made at the mons Veneris and the divided tis[sues] are drawn well to the side by retractors, the aggregation of lamellæ [of]

of filaments known as the median suspensory ligament of the clitoris is exposed to view. These are inserted into the dorsum of the clitoris and into the unattached portions of the crura. The clitoris and the suspensory ligament occupy the symphyseal fossa, which, at its base above the pubic arch, measures about three-quarters of an inch in width.

If the suspensory ligament is cut across, and the clitoris is drawn downward, the pubic arch is exposed.

FIG. 388.



Anterior surface of inflated bladder, showing the dorsal, the cavernous, the urethral, and anterior vesical veins, branches of the internal pudic. The pin indicates the dividing line between the two currents—viz. the upper pelvic, above the levator ani, and the lower perineal, on the uro-genital (perineal) floor.

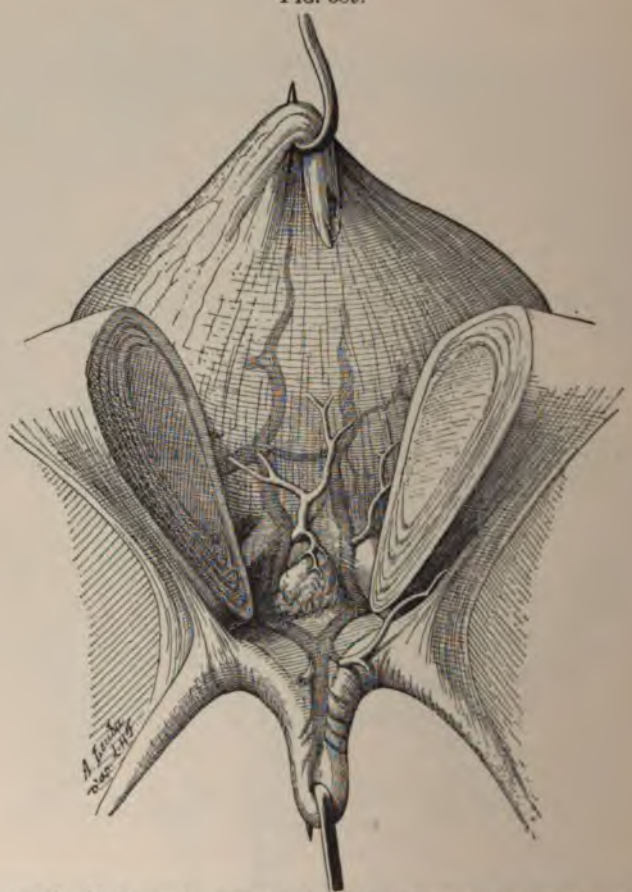
The vessels are imbedded in a fibro-cellular covering, by means of which the vesical veins are applied to the bladder, the urethral to the urethra, and the dorsal to the clitoris. These vessels therefore accompany these organs when the latter are detached from the pubis.

The veins upon the inner pubic surface, though ten to twenty times larger, can distribute only the blood received from the arteries. When the venous circulation has been impeded by labor, pubic section

may be therefore attended temporarily by the outflow of the imprisoned blood, but the apparent hemorrhage is readily controlled by the tampon. After the veins are once emptied they can only convey the blood carried to them by the arteries.

There are no vessels in the fibro-cartilage of the symphysis. In the periosteal covering there are only capillaries. Upon the posterior sur-

FIG. 389.



The separated pubic bones, showing veins behind symphysis and vein going to clitoris.

face of the pubic bones the vessels are small and need not occasion concern to the operator.

The pubis is about two inches in height. The thickness is very nearly an inch when the posterior eminence which marks the line of union of the pubic bones is pronounced (Fig. 383.) The eminence is most marked near the centre, and diminishes toward the upper and lower borders. At the latter points, indeed, the feeling communicated to the finger when introduced from the front is rather that of a depression.

Operation.—The operative methods employed in pubic section vary for the most part, in minor details. The results obtained by Mori

and the Italian school place their rules of procedure in the front rank as regards importance. To avoid, however, confusion, I have thought it best to lay especial stress upon the scheme formulated by Farabœuf and based upon his careful anatomical investigations. They differ chiefly in precision from those formulated by the Neapolitan school. They leave nothing to chance, but serve at each step as a guide and a warning. Morever, their value has been amply sustained by the clinical experiences of Pinard and of Varnier at the Hôpital Baudelocque in Paris.

If consistent with the safety of the mother and child, it is important that labor be allowed to continue until softening, and, as far as possible, dilatation, of the utero-vaginal canal is secured. Where a speedy ending is of importance the preparatory stage may be furthered by means of the Barnes dilators or, as recommended by Pinard and Varnier, by the Champetier bag. It must be remembered that when the support furnished by the pelvic bones in front has been removed, the liability to laceration of the anterior soft structures, if forceps or eversion is employed, is greatly increased by rigidity of the parturient canal. Moreover, the life of the child is additionally imperilled—a matter of special importance in an operation the object of which is the saving of infant life.

Before commencing the operation the patient should take a full bath, the bowels should be cleared out by an enema, and the bladder should be emptied. In all cases the pubes and labia should be shaved ; the abdomen, the external parts, the vestibulum, the anus, and the internal surface of the thighs should be cleansed by scrubbing with soap and water and washing with sterilized water, with alcohol, and with a solution of corrosive sublimate. It should not be forgotten that the patient, the armamentarium, and the *personnel* in symphysiotomy require aseptic precautions as careful and minute as those resorted to in abdominal surgery. The operation demands assistants familiar with surgical methods, and who have studied the steps of the operation. The chance successes in tenement-houses and amid unfavorable surroundings have contributed to a feeling of unwarranted security on the part of many operators. The brilliant records that have been made in the past have, however, been limited to a small number of conscientious students of the subjects. It should be remembered that the general statistics up to date exhibit a heavy morbidity, and that one in nine cases where symphysiotomy has been performed has ended fatally.

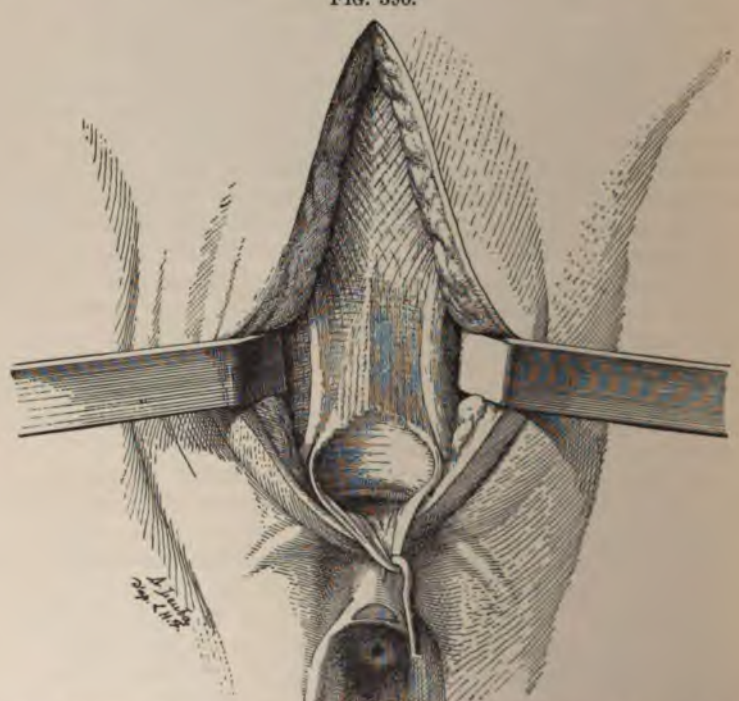
At the time of the operation the patient should be placed in the dorsal position, with the hips drawn to the edge of the operative table, and with the thighs flexed and moderately everted. The latter should be held by two reliable assistants. The inopportune dropping of a limb after symphysiotomy has been the occasion of the violent separation of a sacro-iliac joint. The operator sits or stands between the thighs of the patient. An expert is needed to administer the anæsthetic, a nurse or physician conversant with the methods of treatment employed in the asphyxia of new-born infants should be in readiness, and to promote despatch an assistant is desirable to pass instruments, to aid with the ligatures and dressings, and to supervise aseptic measures.

In determining the situation of the symphysis, it should be remembered that the line of bony union is continuous with the rima vulvæ, the meatus, and the clitoris. Any variation in the direction of the sym-

physis is communicated to these organs. The spines should be located with the finger, and the upper border of the symphysis should be marked for future guidance. A line should likewise be drawn transversely below to indicate the situation of the ligamentum arcuatum, which is easily recognized by the finger through the vestibulum below the clitoris, or, externally, to the side of the clitoris through the skin. The clitoris, as has been already stated, is a longitudinal landmark, but, as it is attached at variable levels in different subjects, is not a guide of latitude. Farabœuf recommends the tincture of iodine as a clean agent for tracing the upper and lower symphyseal boundaries.

During the incision the index and thumb of the left hand should be employed to put the tissues upon the stretch. This is especially necessary if the incision is to be downward. The primary incision should be about three inches long, beginning an inch and a half above the pubis and extending downward to the line previously drawn to define the site of the lower extremity of the symphysis. When the clitoris is attached high up Farabœuf advises a lambda (Λ) incision, the open triangle below, the sides of which should not exceed three-quarters of an inch, enabling the operator to avoid contact with that organ. When the decussating

FIG. 390.



The divided suspensory ligament is drawn downward to expose the passage beneath the arch.

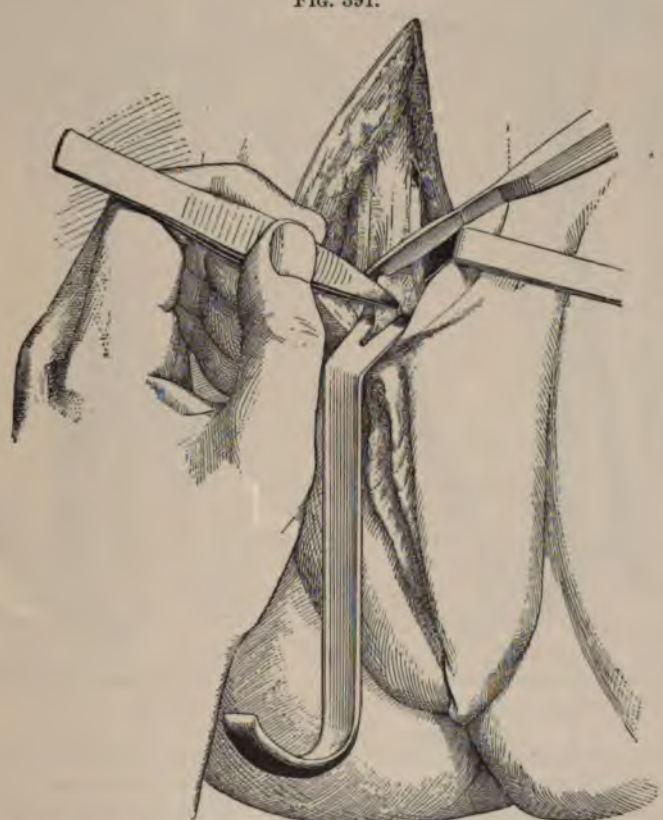
fibres of the fascia are reached, the divided tissues should be drawn well apart with retractors, and the linea alba should be neatly exposed, at first above and then below, by strokes with the bistoury. In this way

the parellel ridges which furnish the attachments to the adductor muscles, and which are covered by the two long longitudinal bands, are brought into view, and the intervening fossa, the sulcus between the spines, and the site of the pubic arch may be felt by the examining fingers.

When the sulcus between the spines is not easily determined, Neugebauer advises the alternate extension and flexion of a limb to aid in its localization. Farabœuf counsels making traction upon the clitoris, and then carefully palpating the anterior symphyseal fossa beneath the suspensory ligament to determine the gap below the pubic arch.

The clitoris should next be detached from the symphysis, and its vessel placed beyond the reach of accidental injury. To accomplish this, traction should be made upon the extremity of the clitoris with the thumb and index to bring into relief the filaments of the suspensory ligament, which should next be seized by forceps, and should be cut

FIG. 391.



Divison of the suspensory ligament. The clitoris is drawn downward, and the ligament is put upon the stretch by the forked extremity of the grooved guard. The ligament is then seized by the forceps and cut across by a knife.

across, above the forceps, by a bistoury. The section should be deep and should extend the width of the fossa to the lateral ridges. The weight of the forceps frequently suffices to cause the descent of the fila-

ments attached to the clitoris and of the clitoris itself. The serous opening beneath the symphysis is then exposed to view, or, when the arch is not perfectly smooth and glistening, a blunt object, like the handle of a scalpel or the rounded extremity of the grooved guard used later for the protection of the posterior symphyseal vessels, may be employed to scrape the surface from above downward to the crura of the clitoris.

After the arch has been brought into view the retractor should be shifted to the upper portion of the divided tissues. The covering fascia should be incised with the cutting surface of a scalpel for a half inch from above downward, beginning at the line previously traced to indi-

FIG. 392.

Preliminary incision of the outer covering between the recti with the cutting surface of the scalpel.

FIG. 393.

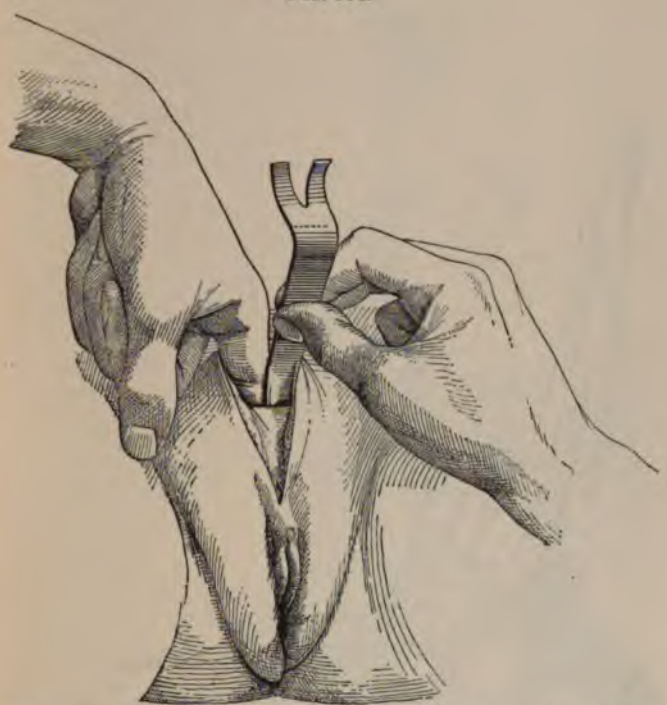
Extension of the opening made by the scalpel by means of scissors.

cate the upper boundary of the spines. The buttonhole opening thus formed should be extended upward for an inch and a half with a pair of scissors, the blunt-pointed blade of which should be passed beneath the linea alba. The recti muscles are thus exposed, between which the surgically clean extremity of the left index finger should be inserted.

If the adminiculum obstructs the way, it should be broken through. Under the guidance of the finger the extremity of the grooved guard should be employed to separate the layer of fat and connective tissue containing the vessels which need to be protected from injury. The line

of denudation should follow the ridge which marks the articulation behind, and should extend downward until the pubic arch is reached. The grooved guard should then be withdrawn, and, with its direction reversed, should be passed beneath the arch behind the pubis from below upward, still under the direction of the finger. When the upper border of the

FIG. 394.



Introduction of the finger and of the grooved guard by the suprapubic route.

FIG. 395.

Knife of Farabœuf.

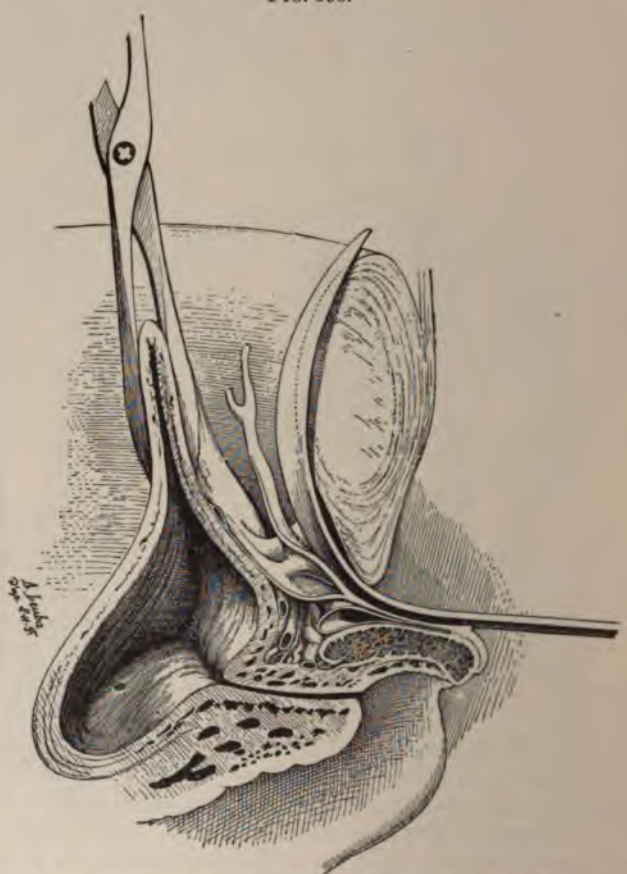
pubis is reached the fingers should be withdrawn and the guard should be held in close contact with the posterior ridge. If the head of the child interferes with the foregoing manœuvre, it should be held above the pelvic brim by the hands of an assistant.

For the section of the symphysis Farabœuf counsels a thin, short, narrow blade. He advises that a deep incision from above downward be first made through the outer fibrous covering, and then with the knife held vertically, with the cutting surface to the front and with the point upon and behind the symphysis, to divide the periosteum, the fibro-cartilage, and the pubic arch. Only the extremity of the blade should be employed. Care should be taken to follow the same route from beginning to end, and, as the periosteum is approached, the pubis should be separated to a slight extent by a moderate abduction of the knees.

When the section is completed the abduction of the knees by assistants is followed by a moderate degree of divulsion at the sacro-iliac articulation. If bleeding results, it should be checked by a tampon of sterilized gauze. If the symptoms are not urgent and the pains are adequate,

Morisani and his pupils in Italy and Zweifel of Leipsic prefer leaving the expulsion of the child to the natural forces. As a temporary support during the continuance of labor Caruso advises a bandage of bichloride gauze (1:4000) around the hips. It is claimed by its advocates that this plan is not the source of unusual pain to the mother, and that the gradual expansion of the pelvic diameters by the spontaneous passage

FIG. 396.



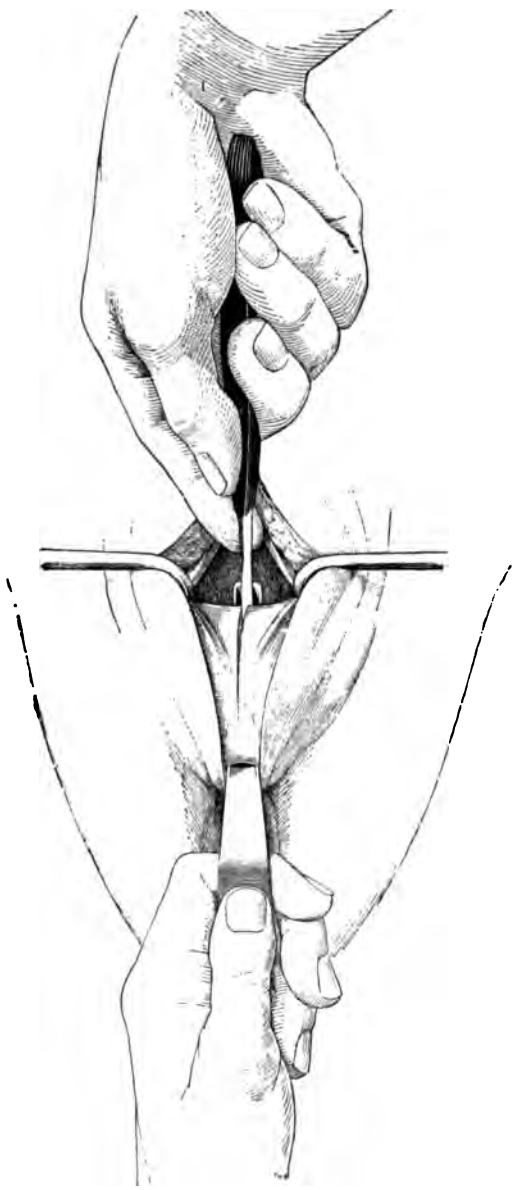
The grooved guard passed behind the symphysis, employed to protect the vessels and organs from the knife during the incision.

of the child is attended with the least degree of risk to the two lives involved.

Farabœuf, on the other hand, insists that forcible divulsion should be employed by the operator directly after section, as engagement is thereby rendered easy and needless compression of the child's head is avoided. Pinard and Varnier report most favorably of this practice in the Hôpital Baudelocque. The anatomical lesion following, when employed within proper limits, is confined to the separation of the periosteum from the ileum for one or two inches. Not a single important ligament, nerve, or

vessel will be injured. The measurements of Farabœuf place the degree

FIG. 397.



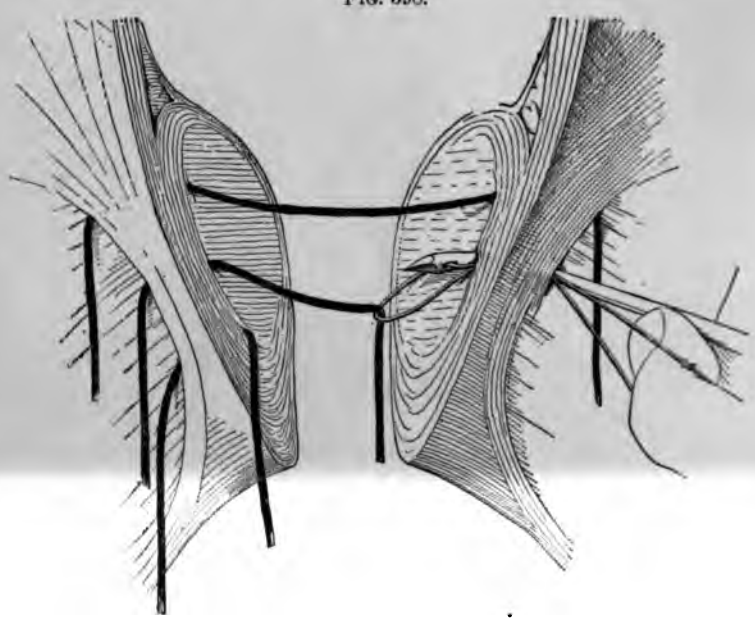
Symphysiotomy. The division of the symphysis is accomplished by (1st) section between the recti muscles, to sever as far as possible the hard, creaking bundles of the fibrous covering, and to trace in front a line corresponding to the groove of the guard, which is held firmly against the ridge corresponding to the articulation behind. (2d) By means of a short, narrow blade with a rounded extremity the operator then cuts through the symphysis from above downward, with the cutting edge of the blade directed forward and under the protection of the grooved guard.

of permissible separation of the pubic bones at $2\frac{3}{4}$ inches (7 centimetres).

Within that limit, in a given case, the distance should be determined by the diameters of the child's head.[1]

The force applied to the knees to accomplish the necessary separation of the ligaments at the sacro-iliac joints should, in the main, be effected by slow, continuous pressure. This is best accomplished by the operator, who stands between the thighs of the patient, and, who, holding the knees with the hands, forces them apart by synchronous movements. In this way he should strip off, stretch, and break through the resistance at

FIG. 398.



Mode of introduction of sutures. These should be of strong silk, and should be inserted from the outer borders of the longitudinal bands, keeping close to the bones. It is best to begin on the right side, which presents the greatest difficulty.

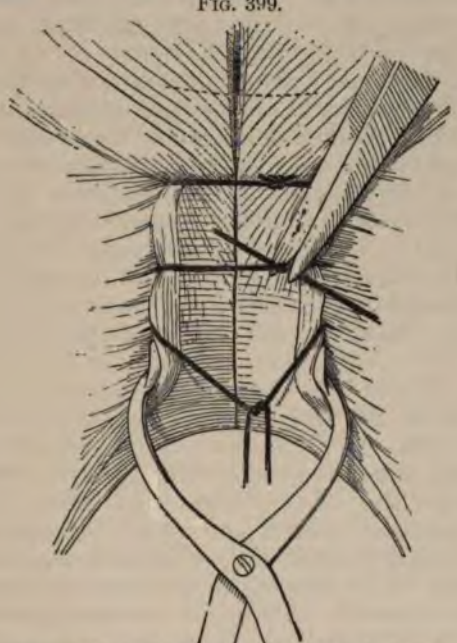
the auricular surfaces, fibre by fibre. But the movement must be intelligently conducted, otherwise the ligaments may yield suddenly and the separation become excessive; or the resistance of a sacro-iliac articulation, due, in rare instances, to ankylosis, more commonly to varying thicknesses of the fibrous connections, or to a retroarticular point of bony contact, may lead to an unequal degree of separation upon the two sides. As the outward rotation of the ilia is always attended by a descent of the pubic extremities, the asymmetry is easily recognized by the differing levels. A very important point in Farabœuf's instruction has been the demonstration that it is possible, by flexion and adduction of the thigh, with the weight of the body thrown upon it, to produce com-

[1] Farabœuf has invented an ingenious instrument, termed by him the "mensurateur levier-prehenseur," which is capable at the same time of measuring the bilateral diameter of the child's head and of serving as a lever to further its descent. By it the necessary degree of separation can be estimated in advance with approximate exactitude. He has likewise devised a pelvimeter by means of which the antero-posterior diameter of the pelvis can be accurately measured in place of being estimated.

plete fixation at one joint, while force is exerted upon the other. (*Vide* Fig. 379.)

When the child's head is at the pelvic brim advantage may be taken of the increase of the sagittal diameter produced by the extension of the lower extremities, and, during descent, of the increase of the sacro-pubic diameters due to forced flexion. At the outlet, owing to the lack of the pelvic planes, it is usually necessary to employ artificial means to rotate the antero-posterior diameter of the head from the transverse to the conjugate diameter. If forceps or version is resorted to, it must be remembered that, unlike ordinary labor, owing to the lack of support in front, it is the anterior vaginal wall and bladder, rather than the perineum, which are endangered. The gaping, therefore, at the pubic bones should be restrained, as far as compatible with the birth of the child, by pressure upon the sides of the pelvis exerted by the hands of assistants, or, still better, by the fixation-forceps contrived by Farabœuf.

FIG. 399.



Tying the sutures, while the bones are held in place by Farabœuf's forceps.

When labor is ended three sutures of strong silk should be passed through the entire thickness of the fibro-tendinous covering of the symphysis to the bone, beginning outside the longitudinal band which furnishes on each side the boundary to the symphyseal fossa. In tying the sutures care should be taken to bring the pubic bones into close contact—an action admirably accomplished by the fixation-forceps of Farabœuf.

Caruso[1] gives the Italian method as follows: Prepare and disinfect everything required for the operation (matting, gauze, sutures, a curved

[1] Caruso, "Contributo alla pratica della sinfisiotomia," *Annali di Ostetricia e Ginecologia*, No. 4, April, 1892.

blunt-pointed bistoury with solid handle, forceps, etc.). Place patient in obstetrical position at edge of bed; shave the pubes and labia majora; disinfect suprapubic region, vulva, perineum, and vulvo-vaginal canal; introduce silver female catheter into the bladder. Then try to determine the situation, the height, the width, and the direction of the articulation. Feel the upper border and the sulcus between the spines, the lower border, the anterior and posterior fibrous coatings. Determine the relief furnished by the interosseous fibro-cartilage. Commence incision 1.5 centimetres above symphysis; cut vertically downward through the soft structures, directing the incision to the left when in the proximity of the clitoris: 7 to 8 centimetres will suffice. Separate the recti, and nick the insertions if necessary to facilitate access to the prevesical tissues. Then, holding the palmar surface of the index against the inner surface of the pubis, push downward to the lower border of the articulation. An assistant should hold the urethra downward and to the right with a sound, while the operator cuts with a blunt-pointed bistoury from above downward and from before backward, until the triangular ligament is reached.

At this point, however, Caruso advises raising the handle of the knife, and, while he continues to cut downward, directs the blunt extremity to the front. The separation is announced by a peculiar creaking characteristic sound and by the space (3–4 cm.) between the pubic bones. At this moment the cavity produced by the separation of the pubis should be tamponed with corrosive-sublimate gauze. During the birth of the child the ilia should be supported by assistants. Finally, six to seven sutures should be passed through the soft tissues, taking pains to include the perichondrium for at least a centimetre from the divided articular surfaces. Then dress with sublimated gauze and with sterilized cotton.

Recently, Dr. Edward A. Ayers has reported four cases of symphysiotomy in which the subcutaneous method was employed. The mothers all recovered. In one instance twins were delivered; both survived. In another instance a child weighing seven pounds was born, and is still living. Two of the children were born dead.

Dr. Ayers' operation consists in raising the clitoris and passing beneath a narrow sharp-pointed scalpel through the mucous membrane from below upward in the line of the symphysis, to within a half inch of the upper pubic border. A straight blunt-pointed bistoury is then substituted, and is employed to cut through the tissues of the joint. Meantime the bladder and urethra should be held to one side with a sound, and a finger in the vagina should follow the blunt point of the bistoury during its descent through the tissues of the joint.

Theoretically, the advantage of preserving the integument intact does not seem to justify the sacrifice of the steps by means of which hemorrhage is surely guarded against, and the bladder and retrosymphyseal space are protected.

Doubtless the weak side of symphysiotomy is the imperfection of all the methods thus far devised to secure coaptation of the parted surfaces after the operation. Ordinary bandages and binders become quickly soiled and require frequent changes. Metallic contrivances to exercise pressure on the hips and plaster-of-Paris bandages chafe the skin and

lead to the formation of bed-sores. To a less extent the same is true of rubber-plaster strips which encircle the pelvis. For this reason Dr. Dawbarn recommends not to surround the pelvis entirely, but to use strong adhesive-plaster strapping four inches wide, starting just behind each trochanter and crossing over the pubis. If, then, the first strap is reinforced by two further thicknesses of plaster, he states a very reliable splint is produced.[1] The proposition to favor the union of the pubic bones by placing the patient upon a cot-bed with sloping sides seems open to the objection that in the prolonged dorsal position painful points of pressure will of necessity be developed.

For these and similar reasons especial stress must be placed upon direct suturing of the symphysis, either by silver wire passed through the bones by means of drills adapted to the purpose, or by strong silk sutures made to traverse the fibrous structures which overlie the cartilage and anterior borders of the pubic bones. The latter plan is advocated by Farabœuf, by Pinard and his colleagues at the Baudelocque Hospital, and by Caruso in Italy. By the aid of deep sutures the accidental loosening of the external belt is deprived of much of its importance. In all cases the patients should lie with outstretched limbs and with the feet turned inward. Pinard commends highly a bed manufactured by Bonamy and Sarney of Paris, of which the essential part is a frame with cross strips of webbing to be placed beneath the patient. When the bed-pan is employed the frame is raised by means of pulleys, and lifts the body of the patient from the bed without subjecting the pelvis to any disturbing movement.

A certain degree of diastasis following symphysiotomy is by no means rare. It is, however, for the most part, temporary, ending after weeks or even months in solid union. A slight degree of mobility does not prevent ordinary exercise in the erect position. An extensive separation may be the source of great discomfort. In one instance which came under my notice, where recovery ultimately took place, the patient's sufferings were for a time extreme, and led her frequently to beg me, when making my hospital visits, to put an end to her existence.

Prognosis.—In the 278 cases of symphysiotomy collated by Neugebauer[2] between the years 1887 and 1894 there were 31 deaths—*i. e.* the mortality was 11 per cent. In the report of Morisani (at the International Medical Congress in Rome, 1894) the same result was obtained. Of 266 children alive at the time of operation, 17, or 19 per cent., died during or a few hours subsequent to labor. In 1894,[3] according to a second report by Neugebauer, there occurred, so far as he was able to collect them, 106 cases, but details were only given in 89. There were in the latter number 8 maternal deaths (9 per cent.), while the infantile mortality was 13, or 15.3 per cent. Harris reported from the United States and Canada 74 cases in fifteen years to June, 1895 (71 in the last two years and seven months): 10 mothers and 18 children perished. The gross mortality, therefore, both maternal and infantile, will be seen

[1] "A Case of Symphysiotomy," by Robert H. M. Dawbarn, *The Am. Journ. of Obstet.*, March, 1896, p. 362.

[2] *Fremmel's Jahresbericht für Geb. und Gynäk.*, 1893, art. by Neugebauer.

[3] *Idem*, 1894.

to be heavy. Deductions made from these and similar aggregations ar however, apt to be misleading. They make no allowance for apprentic work, and yet in every new operation a certain number of casualties the sad price by which experience is purchased. They do not take int account the deaths for which the operation is in no wise responsible— viz. those resulting from non-puerperal diseases in childbed, from septi infection incurred during labor, from eclampsia, from the lowered vital ity of the patient due to long waiting, and from injuries resulting fro attempts at forcible delivery.

A juster perspective is obtainable from the study of the reports o selected operators of large experience. Thus Morisani in 55 cases op rated upon by him between March, 1887, and October, 1892, had a los of but 2 mothers and 3 infants. Zweifel has had 27 cases (to en of 1894), with the loss of two infants and with no maternal deaths Caruso in response to a personal letter wrote me that for the year 189 from January 1 to November 28, there had been in Naples 12 symphysi otomies. The mothers all recovered; 3 infants died. Guéniot has ha 10 operations; the mothers recovered, 1 child died. Pinard has re ported that up to January 1, 1896, of 69 symphysiotomies in the Hôpita Baudelocque 7 mothers and 8 children died; 2 of the maternal death were due to pneumonia, and 4 to infection incurred before entrance int the hospital. He regarded none of the accidents and complications a due to the operation. Queirel[2] states that in 55 cases occurring in th practices of Pinard and Varnier before the employment of symphysi otomy, in 193 cases of pregnancy, 152 children perished, whereas sinc its employment 41 children have been saved.

The evidence is therefore clear that in experienced hands and unde proper conditions the prognosis of symphysiotomy both as regard mother and child is favorable, and that the operation is entitled to high standing among the measures available in the treatment of dif ficult labor. Its worst enemies are those who preach its simplicit and who ignore the risks involved in its employment. It is not i all cases easy of accomplishment. The avoidance of hemorrhage an lacerations calls for constant vigilance, and the after-treatment involve an infinite amount of painstaking.

Indications.—Symphysiotomy is advocated in contracted pelves as substitute for high forceps, for version, and for premature labor t diminish the infant mortality due to these manœuvres. It finds it natural place in moderate degrees of pelvic deformity. Below 2 inches in the flattened and 3 inches in the juxto-minor pelves, owin to the risk of lacerations of the vesical and utero-vaginal tissues inciden to the excessive separation of the pubic bones, it possesses a question able advantage over the Cæsarean section. As an additional resource i obstetric practice its importance cannot be too highly valued. That it revival makes all other measures, which imperil to a greater extent th life of the fœtus, criminal, is an assumption that seems hardly war ranted. An operation which to date has involved a maternal death-rat

[1] *Vide* Heinricius, "Ein Fall von Symphysiotomie," *Monatschr. f. Geb. und Gynäk* April, 1896, p. 293.

[2] Queirel, "Symphysiotomie et le Forceps au Détroit Sup.," *Ann. de Gyn.*, Feb 1896.

of 11 per cent.,[1] which even in skilled hands may be attended by serious injuries to the soft parts, and which is often followed by a tedious convalescence, to my mind should not be undertaken without the consent of the parties interested.

Between 2¾ and 3 inches (3–3¼ in juxto-minor pelves) I should personally prefer symphysiotomy. It is less dangerous than the Cæsarean section, and the alternative is usually craniotomy aud the basiotribe. Above 3 inches in flattened pelves the chances are more favorable than is generally thought to the birth of the child by the natural passages. Leopold reports 21 cases in one year where the pelvis measured from 3 to 3½ inches in which spontaneous delivery took place. If accommodation of the head to the pelvis does not occur as a result of uterine action, before deciding upon symphysiotomy the physician, it seems to me, should consider conscientiously his own qualifications, the character of the assistance at his command, and the extent to which antisepsis in the given case is practicable.

[1] Of course many of the deaths were not due directly to the operation. Comparisons, however, are made with other measures where the same exceptions could justly be claimed.

THE SURGERY OF THE THYROID GLAND.

BY ROBERT F. WEIR, M. D.,

AND

EDWARD M. FOOTE, M. D.

THE NORMAL GLAND.

THE *glandula thyreoidea* (θύρεος, shield, and εἶδος, form) is a compound, tubular, ductless gland. It develops from the mucous membrane of the branchial clefts, but the connection with the parent membrane is lost in the second month of fœtal life. The foramen cæcum of the tongue is thought by most embryologists[1] to be the origin of the obliterated outlet-canal—the so-called *ductus thyreoglossus*. In about 15 per cent. of the cases examined[2] the foramen cæcum opened into a blind canal averaging one-quarter of an inch in length.

In the adult the thyroid gland consists of two lateral lobes situated on each side of the larynx and trachea and connected by a narrow isthmus. The isthmus covers the second tracheal ring, and usually rests also upon the first or third ring.[3] The attachment of the isthmus to the trachea is not an intimate one, and by a transverse division of the overlying fascia it can be pushed downward from one to three rings, and an increased space thus readily obtained for tracheotomy.

The gland varies considerably in size and shape. The weight is usually between one and two ounces. It is relatively greater in women and children than in men.

The lateral lobes measure from two to three inches vertically, and have a breadth of one and a half to two inches. They are roughly triangular on section. The anterior surface is covered by the sterno-thyroid and sterno-hyoid muscles. The posterior surface is concave and is closely attached to the trachea and larynx. Externally the gland is in relation with the cervical vessels.

From the isthmus or from one of the lobes a process of gland-tissue, called the pyramid, often extends upward toward the hyoid bone. Detached bits of thyroid tissue—*accessory thyroid glands*—are found in about 10 per cent. of the subjects examined. They may be either in the median line or on one or both sides. They are most often situated in the region of the hyoid bone, but they have been found as high up as the base of the tongue[4] on the margin of the lower jaw, and as low

[1] Lanz, "Zur Schilddrüsenfrage," *Samml. klin. Vortrage*, No. 98, 1894.

[2] Marshall, *Journ. Anat. and Phys.*, Jan., 1895.

[3] Monclaire, *Bull. Soc. Anat.*, Paris, 1895, vol. ix. No. 3.

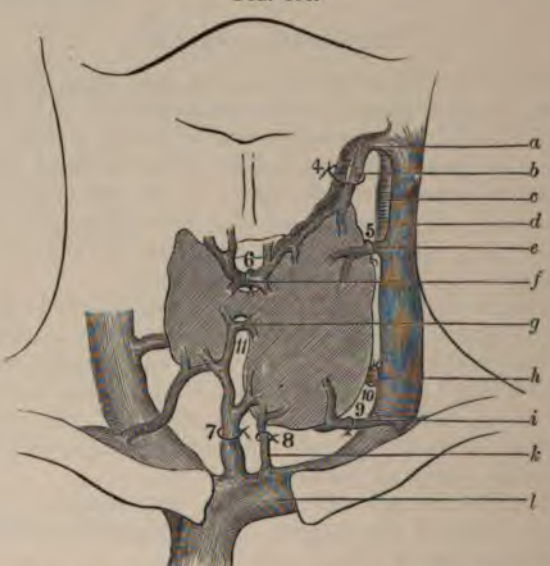
[4] Haeckel, "Eine Cyste d. Ductus thyreo-glossus," *Arch. f. klin. Chir.*, 1894, vol. xlviii. p. 617.

down as the clavicle, or even within the thorax. There are on record also a few cases in which a mass of thyroid tissue has existed within the trachea. Aside from its rarity, the chief interest in this anomaly lies in the danger of resulting suffocation.

The superior and inferior thyroid arteries, right and left, afford an abundant blood-supply. Their total calibre is nearly one-half that of the combined cerebral arteries. The arterial arrangement is irregular in about one person in ten. The arteria thyroidea ima may take the place of one or more of the branches mentioned.

The veins are without valves. From their size, number, and frequent anastomoses they have been called the thyroid plexus. They drain into the facial, jugular, and innominate veins (Fig. 400).

FIG. 400.



sup. thyroid artery; *b*, sup. thyroid vein; *c*, carotid artery; *d*, internal jugular vein; *e*, accessory sup. thyroid vein; *f*, sup. communicating thyroid vein; *g*, inf. communicating thyroid vein; *h*, accessory inferior thyroid vein; *i*, inferior thyroid vein; *k*, thyroidea ima veins; *l*, left innominate vein. The numerals indicate the points where the above-mentioned veins are ligated (from Kocher).

The substance of the gland is made up of tubules bound together into lobules by loose connective tissue, and enclosed in a fibrous capsule—capsula propria.[1]

The tubules are lined with a single layer of cylindrical cells and contain a clear, pale, colloid material. They vary in diameter from .04 to .12 mm. The blood- and lymph-vessels come into close connection

[1] The fascial layers which surround this, as every other gland, are often thickened in goitre; and they, together with the remains of atrophied overlying muscles, are sometimes spoken of as the "external capsule" of the gland. Thus, Billroth and Wölfler, in speaking of "intracapsular" resection, mean by that a dissection carried on within these fascial layers, but outside of the capsula propria of the gland. The intracapular resection of Kocher and Wolff, however, is performed inside of the capsula propria (Burckhardt, "Ueber d. Kropf Kapsel," *Cent. f. Chir.*, 1894, No. 29, p. 673). By "internal capsule," likewise somewhat confusing, is sometimes meant the distinct fascial covering which invests nodular and cystic growths in the substance of the thyroid.

with the epithelium of the tubules, but no direct connection between their lumina has been shown to exist.

The function of the thyroid gland is unknown. It has been clearly proven, however, that it plays an important part in the economy. Its removal or atrophy produces in many instances profound changes, which in general are more marked in young individuals. These changes manifest themselves in neurotic, myxœdematous, and cachectic symptoms. It is thought by some observers that the tetanus and the myxœdema which often follow complete removal of the thyroid in man and animals are simply acute and chronic manifestations of the same cause, to which Kocher[1] has applied the name *cachexia thyreopriva;* both he and Horsley[2 3] incline to the opinion that cretinism is a closely-allied affection due to the absence or insufficiency of the thyroid at an age when its influence on the development is very strong.[4] Whether this influence of the normal thyroid is to destroy some injurious substances in the blood, or to secrete a substance essential to metabolic processes, or whether it works in some other way, has not yet been determined.

Circulatory Disturbances.

Venous congestion of the thyroid may result from any cause which compresses the cervical veins—*e. g.* crying, cornet-playing, etc.

Hyperæmia of vasomotor nervous origin is of more importance. In its simplest form it occurs in many women with menstruation, parturition, and lactation, subsiding again as soon as these conditions pass. A permanent engorgement of a similar character is found in exophthalmic goitre[5] (Graves' or Basedow's disease), which is considered by many to be a neurosis, and by some to be due to excessive thyroidal secretion. The arteries and capillaries may become so dilated that a murmur is heard and pulsation plainly felt. The name *aneurysma serpentinum* has been applied to this condition.

Inflammation.

Either the normal or the goitrous thyroid may become inflamed, but most of the few cases which have been reported have occurred in the pathological gland. The inflammation may resolve or go on to suppuration and abscess-formation. The abscess, if not relieved, may break internally or into the anterior mediastinum—rarely into the trachea or œsophagus, or the pus may become encapsulated and a site for the deposit of lime salts or the growth of fibrous tissue.

Naturally, germs introduced by a hypodermic needle or through a wound may cause an abscess, but in most instances inflammation of the

[1] Kocher, "Zur Verhütung d. Cretinismus u. Cretin. Zustände nach neueren Forschungen," *Deut. Zeit. f. Chir.*, 1892, vol. xxxiv. p. 601.

[2] Horsley, "Functions of the Thyroid Gland," *Brit. Med. Journ.*, 1892, vol. i. pp. 215, 265.

[3] Committee of the Clinical Society of London, "Report on Myxœdema," *Clin. Soc. Trans.*, 1888, London.

[4] Hofmeister, "Experiment. Untersuch ü. d. Folgen d. Schilddrüsenverlustes," *Beit. z. klin. Chir.*, 1893–94, vol. xi. p. 441.

[5] Orth, *Lehrbuch d. spec. Pathol. Anatom.*, 1887, vol. i. p. 576.

thyroid[1] [2] is secondary to an infective process elsewhere in the body, such as typhoid or puerperal fever, rheumatism, pyæmia, diphtheria, etc. Idiopathic abscesses are also mentioned.

The **treatment** consists in incision and drainage. Escape of pus is apt to be followed by repeated hemorrhage from the wall of the abscess. This, however, is readily controlled by distending the cavity with strips of aseptic gauze.

Tuberculosis.

It was formerly supposed that the thyroid escaped tubercular infection, but this is not the case.[3] In general miliary tuberculosis it suffers as do the other organs.

Of greater surgical interest is the rarer occurrence of secondary tubercular nodules. P. Bruns[4] has collected 6 such cases, and 1 in which the tuberculosis of the thyroid was primary and greatly resembled in its clinical appearance malignant disease.

Echinococcus.

In its early stages the symptoms of echinococcus of the thyroid are so like those of goitre that the true nature of the lesion is not likely to be suspected. As the disease progresses the inflammation surrounding the cysts sets up firm adhesions and may result in the destruction of neighboring tissues. Thus a cyst may rupture into the trachea with fatal result.

Sometimes the thyroid is one of many organs affected; sometimes it alone is involved—a selection which it is impossible satisfactorily to explain.

The best results in **treatment** have been obtained by free incision, followed by evacuation of the contents of the cysts or excision of that portion of the gland which contains them.

In uncomplicated cases the **prognosis** is very good.

For the details of this subject the reader is referred to an exhaustive article published by Henle[5] to which a complete bibliography is appended.

Benign Tumors and Goitre.

The name "goitre" has often been applied to every permanent morbid enlargement of the thyroid gland. Modern writers, however, agree in excluding from this group the parasitic affections—tuberculosis and echinococcus—and the malignant tumors. There are in addition certain purely local new growths—cysts[6] and adenomata[7]—the nature

[1] Ransohoff, "Thyroid Abscess," *Trans. Am. Surg. Assoc.*, 1894, p. 275.

[2] Tavel, "Ueber d. Aetiologie d. Strumitis," Basel, 1892; abstract in *Centralbl. f. Chir.*, 1892, No. 12, p. 243.

[3] Fränkel, "Ueber Schilddrüsentuberculosa," *Virch. Arch.*, 1886, vol. civ. p. 58.

[4] Bruns, "Struma tuberculosa," *Beit. z. klin. Chir.*, 1893, vol. x. p. 1.

[5] Henle, "Ueber d. Echinococcus d. Schilddrüse," *Arch. f. klin. Chir.*, 1895, vol. xlix. p. 852.

[6] Butlin, "A Discussion on the Surgical Treatment of Cysts, Adenomata, and Carcinomata of the Thyroid Gland," *Brit. Med. Journ.*, 1895, vol. ii. p. 901.

[7] Wölfler, "Ueber d. Entwickelung ü. d. Bau d. Kropfes," *Arch. f. klin. Chir.*, 1883, vol. xxix. pp. 1 and 754.

of which is now so well understood and it is desirable in speaking of these growths to give them their right names. As far as possible, that is done in this article, though to avoid misunderstanding and needless repetition the word "goitre" is often made use of to include these benign tumors. In many cases, indeed—even after operation—it is not possible sharply to draw the line between hypertrophy and a new growth. In others there are one or two cysts or adenomata so perfectly encapsulated in an otherwise normal gland that, anatomically at least, there is no excuse for referring to the condition as goitre.

Fibroma, chondroma, and osteoma are rarely seen in the thyroid.

Malignant Tumors.

Sarcoma of the thyroid is usually of the round-celled variety. Carcinoma is rather more common than sarcoma, and, like it, is generally of a soft, cellular type.

The **diagnosis** between the two is often difficult. Adeno-carcinomata and adeno-sarcomata occupy a middle ground. In structure and by reason of their metastases they are malignant, but they oftentimes grow slowly, and do not recur with the virulence which their microscopical appearances seem to predicate, and they are therefore much more amenable to treatment by operation.

Malignant tumors may develop in a normal or in a goitrous gland. They are apt to form metastases, single or multiple, in some bone of the head or thorax, or in the humerus,[1] or in the lungs.[2] Extension into adjacent tissues, including the trachea, takes place very rapidly in cancer of the thyroid, so that the operative results are very discouraging.

Goitre.

Synonyms.—Eng. Bronchocele; Fr. Goître; It. Gozzo; Ger. Kropf, Struma.

Goitre (Lat. *guttus*, throat) is a permanent non-malignant enlargement of the thyroid gland or of one of its lobes.

It occurs endemically, epidemically, and sporadically. No part of the earth is free from it, but it is found chiefly in certain mountainous districts, notably in Switzerland.

Endemic goitre is often associated with cretinism, a disease, as is well known, marked by idiocy, deafness, and a peculiar thickening of the soft tissues and imperfect development of the skeleton. This is now thought to be due to the congenital or early acquired loss of function of the thyroid gland; and as such it has been spoken of as the full manifestation of myxœdema.[3] [4]

Goitre may be congenital or arise at any age, but the period of

[1] V. Eiselsberg, "Ueber Knochen-metastasen d. Schilddrüsenkrebses," *Arch. f. klin. Chir.*, 1893, vol. xlvi. p. 430.

[2] Middeldorpf, "Zur Kenntniss d. Knochen-metastasen bei Schilddrüsentumoren," *Arch. f. klin. Chir.*, 1894, vol. xlviii. p. 502.

[3] Holmes, "Sporadic Goitre: Its Varieties and the Results of Modern Treatment," *Lancet*, 1895, Nov. 9, p. 1155.

[4] Murray, "Diseases of the Thyroid Gland," *Twentieth Century Pract. of Med.*, 1895, vol. iv. p. 752.

puberty is especially favorable for its development. More women than men are affected.

Heredity is a powerful predisposing factor in the development of goitre. Repeated pregnancy and occupations which obstruct the circulation in the cervical veins, such as mountain-climbing, bearing weights on the head, working or studying with the head bent forward, are other favoring causes.

What is the *exciting cause* of goitre? This question has given rise to no end of speculation and investigation. Lack of sunshine, damp and cold dwellings, snow-water, air of a certain quality, and many other things, have been brought forward at one time or another as solutions to the problem. Those theories which placed the responsibility for the disease upon the drinking-waters of goitrous districts have found the widest support. Just what constituents of such waters may be the real causes of goitre has been, again, matter of dispute. In 1877, Klebs[1] claimed to have found the bacterial agent in water of a certain goitrous district, but the claim has not been substantiated. Others have attempted to show that goitre is indigenous to certain geological strata, and that the amount of magnesia, chalk, etc. contained in the drinking-water of such regions is the etiological factor. This view has many supporters, but the more goitrous districts were investigated the more dissimilar were found to be the geological conditions of the soil where it is endemic.

In the last decade Kocher,[2] by the examination of no less than 76,000 school-children in the canton Berne, Switzerland, brought forward a mass of evidence of great weight, though not conclusive, that it is not the inorganic but the organic constituents of drinking-water which produce goitre, and that if goitre is found in regions where limestone and magnesia predominate, it is because of the organic impurities that are mixed with these minerals.[3] Some of the evidence was very striking that goitre follows the long-continued use of water of certain wells and springs. Thus, in one school all the children who were free from goitre used water from the same meadow spring, while their neighbors on all sides, who had other water-supply, suffered from the disease. This spring-water contained four times as much calcium and twice as much magnesia as a "goitrous" spring not far away, but only nine kinds of bacteria were found in the former, while the latter contained thirty-three kinds. Injections of a mixture of all the germs obtained from the goitrous spring produced swelling of the thyroids in some rabbits, but no such result followed similar injections into dogs. Kocher is of the opinion that a positive result could only be expected after the injections were many times repeated.

Epidemic goitre occurs almost exclusively in regions where goitre is endemic. It has been observed to follow severe exertion, as forced marching in the case of new recruits, but this is to be regarded at most as a predisposing cause. The same is true of climatic changes.

An interesting point in connection with the etiology of goitre is in

[1] Klebs, *Studien üb. d. Verbreitung d. Cretinismus in Oesterreich. sowie üb. d. Ursache d. Kropfbildung*, Prag, 1877.

[2] Kocher, *Vorkommen u. Vertheilung d. Kropfes in Kanton Berne, Ein Beitrag z. Kenntniss d. Ursachen d. Kropfbildung*, Berne, 1889.

[3] Lustig and Carle, "Sull' etiologia del gozzo endemico," *Gior. d. r. Accad. di Med. di Torino*, 1890, p. 689.

the fact that there seems to be an intimate relation between its origin and the condition of the vasomotor system.[1] Fully one-half of the persons who have a goitre are said to have an abnormal heart.[2]

Pathological Anatomy.—The question in what tissue the morbid growth commences has also given rise to discussion. Wölfler,[3] in his work on the origin of goitre, published in 1880, holds to the theory that fragments of fœtal tissue in the thyroid under favorable conditions resume their interrupted development. Hitzig,[4] who has recently studied the subject, takes an opposite view. He selected goitres from young patients (fourteen to thirty years of age) with the idea of finding portions of the tumor in the early stages of active growth. Thirty-six specimens were examined. In many sections he distinctly found the normal tubular epithelium beginning to grow into pathological nodules. He therefore drew the conclusion that a goitre grows from the normal pre-existing epithelium of the thyroid.

A goitre may involve the whole thyroid gland or any part of it. The right lobe is more often affected than the left one. It very rarely attacks the isthmus alone. It may occupy the normal position of the thyroid or sink downward upon the chest or be *retrosternal* or *retroclavicular*, or *movable—i. e.* at times rising above the sternum, at times sinking out of sight into the anterior mediastinum.[5] It may also completely surround the trachea[6] or be behind the pharynx (Fig. 402). Goitres which are remote from the normal situation of the gland usually develop in an accessory thyroid.

A goitre may grow outward between the cervical vessels, lifting the internal jugular vein forward without displacing the carotid artery, or both vessels may be pushed outward until they lie underneath the outer border of the sterno-mastoid.

The recurrent laryngeal nerve may likewise be dislocated backward, or become adherent to the capsule and undergo degeneration and atrophy or inflammation and thickening.

The trachea may be displaced or compressed, so that its cross-section presents the shape of a D, a sabre, or a crescent[7] (Fig. 401).

Symptoms.—An acute goitre, such as may occur after severe exertion or epidemically in regions where goitre is common, presents a pulsating tumor reducible on pressure. Distention of the cervical veins and dyspnœa are the other prominent symptoms. These vascular tumors may disappear as rapidly as they appear.[8]

In the majority of cases of chronic goitre a painless enlargement of

[1] Vetlesen, *Aetiologiske Studien over Struma*, Kristiania, 1887.

[2] Schranz, "Beiträge z. Theorie d. Kropfes," *Arch. f. klin Chir.*, 1886–87, vol. xxxiv. p. 92.

[3] Wölfler, *Ueber der Entwickelung und Bau d. Schilddrüse*, Berlin, 1880.

[4] Hitzig, "Beiträge z. Histologie u. Histogenese d. Struma," *Arch. f. klin Chir.*, 1893–94, vol. xlvii. p. 464.

[5] Wuhrmann has published details of 75 benign and 16 malignant cases of intrathoracic goitre. In 85 per cent. of the benign cases the extrathoracic portion of the thyroid gland was also affected. (For further particulars see the original article in *Deut. Zeit. f. Chirurg.*, 1896, xliii. p. 1.)

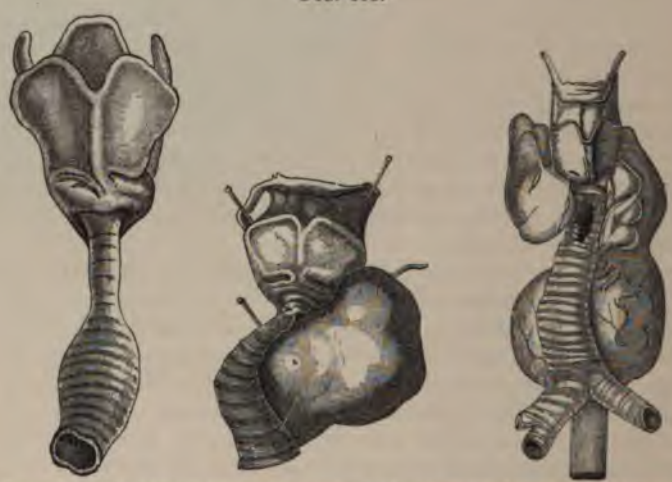
[6] Wölfler, *Chirurg. Behandlung d. Kropfes*, II. Theil, Berlin, 1890; also in *Arch. f. klin. Chir.*, 1890, vol. xl. p. 176.

[7] Demme, *Handbuch f. Kinderkrankheiten*, Bern, 1879.

[8] Wölfler, "Zur chir. Anat. u. Path. d. Kropfes," *Arch. f. klin. Chir.*, 1890, vol. xl. p. 350.

the thyroid first attracts attention. Soon there is added a moderate venous congestion of the face and neck, more marked on exertion. Faintness, palpitation, headache, buzzing in the ears, flashes of light, sleeplessness, and an anxious feeling may accompany the growth of the

FIG. 401.



Distortions of the trachea caused by goitres (from Demme, Lücke, and Krönlein).

goitre. In many cases the tumor attains great size with absolutely no disturbed sensations, while in others the pressure of the enlarged thyroid on the trachea or pharynx, or on the cervical vessels or nerves, causes distressing symptoms.

There may be palpitation of the heart, due to chlorosis or to increase of blood-pressure in the right heart, or, as Schranz[1] believes, to degeneration of the vasomotor nerves. In 67 per cent. of 308 autopsies of goitrous individuals he found cardiac affection.

The dilatation of the veins may also be due to forced expiration caused by compression of the trachea, or to paralysis of the glottis from pressure upon the recurrent laryngeal nerve, or to direct pressure of the goitre upon the cervical veins.

The direct pressure on the trachea can so far narrow its lumen or alter its shape that the respiration becomes characteristic. The inspiration is slow and strained, with distinct stridor, while the expiration is forced and hurried. This can progress until the patient is in danger of asphyxia, especially if the goitre is so situated as to bend the trachea at an angle or if the tumor extends behind the sternum.

A difficulty may similarly exist in swallowing, though such is not usually the case in benign, uninflamed goitres.

Pressure on the recurrent laryngeal nerve generally produces hoarseness or aphony. This is to be regarded as a serious complication when an operation is considered. Occasionally it happens that the paralysis, being due to simple pressure without nerve-degeneration, is relieved by the removal of the tumor.

[1] Schranz, *loc. cit.*

The special forms of goitre present a few symptoms peculiar to themselves.

Congenital goitre, especially if it surrounds the trachea, may cause death by strangulation (Fig. 402), or it may be so large as to interfere with birth. In these cases, on account of the almost invariable necessity of tracheotomy, operative treatment offers a forlorn hope. Four cases have been reported, of which one[1] was successful.

FIG. 402.

Congenital goitre encircling the trachea and œsophagus (from Kaufmann).

Retrosternal and *retroclavicular* goitres tend to sink more and more behind the anterior thoracic wall. If pedunculated, such goitres, as already remarked, may rise into the neck in expiration to sink again in inspiration. Hence the name *movable goitre* (goitre plongeant). If the larynx is movable, such a goitre may remain for hours wholly substernal. In this form of goitre the danger from pressure upon the trachea, innominate veins, the left recurrent laryngeal nerve (not the right), or the sympathetic nerves is greatly increased.

An untreated goitre may sometimes exist for years without producing alarming symptoms. Under less favorable conditions the symptoms enumerated increase in severity, and may cause death in a variety of ways. The breathing becomes more labored and paroxysms similar to those of asthma set in. Hemorrhage into the substance of the goitre or into a preformed cyst may cause such additional pressure on the trachea that the mucus from a coexisting bronchitis may block its lumen. In other cases no such mechanical obstruction is found, and the failure of respiration is attributed to chronic carbon-dioxide poisoning, or hemorrhage into the medulla, or paralysis of the muscles which open the glottis, with spasm of those which close it.[2]

Diagnosis.—The diagnosis of a goitre is usually easily made. A tumor lying upon the trachea, moving with deglutition, is nearly always connected with the thyroid. If, in addition, the carotid is found behind it or at its outer side, and if there is venous congestion of the face and neck and complete or partial paralysis of the vocal cords, the diagnosis is absolutely certain.

It is more difficult to determine the character of the enlargement. For this purpose the tumor should be lifted forward by one hand, or by an assistant, while the patient bends his head downward. In this manner palpation is most favored, and it is often possible to feel the smooth elastic nodules of adenomata and cysts, the smooth surface of diffuse parenchymatous enlargement, or the irregularities of a fibrous goitre.

Aspiration of the contents of a cyst is not a good means of diagnosis. If performed at all, a good-sized trocar should be used, and the surgeon should be ready to operate at once, as dangerous hemorrhage may follow even a simple puncture. It is scarcely necessary to say that such

[1] Lugenbühl, "Die operative Behandlung d. Struma Congenita," *Beit. z. klin. Chir.*, 1895, vol. xiv. p. 713.

[2] Seitz, "Der Kropftod durch Stimmbandlähmung," *Arch. f. klin. Chir.*, 1883, vol. xxix. pp. 146, 203.

puncture should be made only under conditions of the strictest surgical cleanliness.

Classification.—The enlargement of the thyroid gland—known more properly as goitre—may be due to a general hyperplasia of the whole gland or a part of it. This hyperplasia may be either *parenchymatous*, the cells being multiplied; or *follicular*, the contents of the alveoli being increased; or *vascular*, the blood-vessels especially being affected.

Moreover, in a growth of any one of these three types secondary changes may take place, with the resulting formation of *fibrous tissue* or *cysts* containing *gelatinous* or *hemorrhagic* fluid. By necrosis of the intervening septa these cysts may reach a great size. There may also be *calcareous* deposits.

Hence the nomenclature applied to these changes has become rather mixed. The following classification is substantially that proposed by Virchow[1] thirty years ago, and, though not an exact one, it is both simpler and more practical than any since brought forward:

Simple hyperæmia of the thyroid is usually a transient condition, disappearing with the disappearance of the cause which produced it—*e. g.* menstruation, pregnancy, etc. If it is often repeated, the enlargement may become permanent.

Vascular goitre is made up chiefly of blood-vessels. The tumor can be reduced considerably by pressure. Pulsation and a murmur are often present. This pulsation must not be confounded with the impulse transmitted from the carotid. Vascular goitre, except as it occurs in connection with Graves' disease, is usually found in young patients.

Parenchymatous goitre presents various appearances. If the process is diffuse and the follicles small, the result is a small, smooth, elastic tumor. In most cases the growth is irregular, and nodules (*adenomata*) are formed, or the contents of the follicles increase and undergo colloid degeneration (*colloid goitre*). The septa between these may atrophy, and cysts are formed filled with gelatinous fluid of varying consistence and more or less stained with blood (*cystic goitre*). The adenomatous nodules are firm and often completely encapsulated. They may reach the size of an egg.

In goitre of long duration the amount of fibrous tissue may be so large that the name *fibrous goitre* is appropriate. Such a tumor is firm and nodular.

Such may be considered the types of goitre, but, practically, most of the cases are "mixed"—*i. e.* made up of fibrous and parenchymatous tissues and follicular cysts, so that a sharp differentiation into classes is difficult. The impossibility in some instances of making a clinical diagnosis between cases of true goitre, on the one hand, and cysts or adenomata in an otherwise normal thyroid, on the other hand, has already been mentioned.

Nor is it always easy to tell whether a given nodule contains fluid or is solid. Fluctuation is not always to be obtained, and translucency can only be made out in large unilocular cysts lying near the surface.

The **diagnosis** between other cervical tumors and a goitre which has developed in the normal situation of the thyroid gland is easy, because of the central position of a goitre, its movement in deglutition, etc.

[1] Virchow, *Die Krankhafte Geschwülste*, Berlin, 1867.

When an accessory thyroid is affected the diagnosis is more difficult and may be impossible.[1]

Prognosis.—The prognosis in acute goitre is very good. In chronic goitre it depends upon the severity of the symptoms and the ability of the patient to bear them. The age of the patient and the condition of the lungs and heart are chiefly to be noticed.

The development of operative treatment to its present condition has done much to improve the prognosis, and the treatment by the use of the thyroid extract in cases formerly demanding surgical interference seems to promise still greater hope.

Treatment (*non-operative*).—The treatment of goitre is hygienic, medical, and surgical.

Persons who are predisposed by heredity to goitre should avoid—(1) a residence in a district where the disease is endemic; (2) the use of the water of such a district except when sterilized; (3) an occupation which produces congestion of the cervical veins.

Recent cases of goitre occurring in a goitrous district have been cured, and old cases have been improved, by removal to a region free from the disease.[2] The introduction of water from a district free from goitre reduced the proportion of goitrous school-children in Rupperswyl from 59 to 25 per cent.[3] Many other instances might be cited to show the value of prophylactic hygienic measures.

Internal Remedies.—Drugs have little or no effect upon long-standing cases of goitre. Upon recent enlargements several substances have a decidedly beneficial influence. Among these iodine and its compounds have long held the first place.

Given internally, iodide of potassium (grains 5–15 daily) has, according to Naumann and others, a salutary effect in cases of parenchymatous goitre, especially in patients not over twenty years of age.

Improvement comes rapidly, if at all. Larger doses are inadvisable. They may produce palpitation of the heart or swelling of the gland, with fever and rapid emaciation. This condition has been spoken of as iodism, but it is more likely to be due to the rapid discharge of malsecretions of the thyroid into the circulation.

Fresh thyroid glands, taken from sheep or lambs, and extracts made from them, have been employed internally in goitre since 1893. So many favorable results have been reported from this treatment that it is strongly to be recommended before operative interference is entertained. All observers, however, agree that cysts and large collections of colloid material and fibrous tissue are unaffected by this treatment. Hyperplastic tissues and adenomata shrink, but do not entirely disappear. As a result of this atrophy smaller colloid nodules, which before were impalpable, may become prominent. They are also more easily removed than from the untreated hypertrophied gland.[4] [5]

[1] Riedel, "Die Geschwülste am Halse," *Deutsch. Chirurgie*, Lief 36.

[2] Naumann, *Ueber d. Kropf u. dessen Behandlung*, Lund, 1892.

[3] Bircher, *Der endemische Kropf u. seine Beziehungen z. Taubstummheit u. z. Cretinismus*, Basel, 1883.

[4] Bruns, "Ueber d. Kropfbehandlung m. Schilddrüsenfütterung," *Beit. z. klin Chir.*, 1894, vol. xii. p. 847.

[5] Knoepfelmacher, "Ueber einige therapeut. Versuche m. Schilddrüsenfütterung," *Wien. klin. Wochen.*, 1895, Oct. 10, p. 715.

Constitutionally, the thyroid extract also exerts a favorable influence, and the general symptoms which goitre causes have often been reported to be improved by its use.

Bruns[1] has reported 60 cases (non-malignant and non-cystic) in which this treatment was employed: 14 were cured, 29 were improved, and 17 were not improved by the treatment. He found that the thyroid extract had a better effect in young patients. The treatment in most cases lasted from three to four weeks.

The dose should be small at first, the equivalent of 2 or 3 grains of sheep's thyroid being given three times a day. This may be increased up to 15 or 20 grains every day or every two days as soon as the tolerance of the patient is determined. The symptoms of overdose are headache, faintness, nausea, palpitation, fever, excessive perspiration, and prostration, and, if the treatment is continued, emaciation.

Attempts have been made to explain the action of thyroid extracts by saying that they give the hyperplastic gland a chance to rest, and that it therefore shrinks in size; but this theory neither harmonizes with what is known concerning hypertrophy and atrophy of other glands, nor does it explain all the facts in connection with the thyroid, as, for example, the fact that the gland remains small after the thyroid feeding is given up.

Before the last (twenty-fourth) Congress of German Surgeons, held in Berlin,[2] Kocher[3] spoke warmly of thyroid treatment. He uses the extract combined with the glycero-potassium phosphate, in 20-grain doses of the latter three and four times a day.

Mikulicz[4] has likewise obtained atrophy of the thyroid, with improvement of the symptoms in goitre, by feeding the patient with thymus glands. The dose must be much larger—four or five times larger—than when thyroid is used. One patient with an old and large goitre took 12 ounces (grams 375) in five weeks with no apparent change in the goitre, but with relief of the previously existing severe symptoms.

The use of thyroid extracts has been even more successful in cachexia thyreopriva (surgical myxœdema), which often follows a complete thyroidectomy.[5] Indeed, it was in this disease that the treatment of thyroid substitution was first employed—originally by the implantation of a part of a thyroid gland in the neck or in some distant part of the body, then by the injection of an extract made from it, and lastly by ingested thyroids or their extracts. Belladonna, pushed to its full physiological effects, has been employed with some benefit in the vascular or exophthalmic goitres.

External Remedies.—The external application of iodine has also been followed by success in a certain number of cases. For this purpose a mixture of iodine, potassium iodide, and glycerin (1 : 5 : 100) is recommended.[6] The external application of an ointment containing biniodide

[1] Bruns, *loc. cit.*

[2] Mikulicz, "Die Chirurg. Behand. d. Basedow'schen Krankheit," *Verhandlungen d. Deutsch. Gesellschaft*, 24 Congress, 1895, Berlin, p. 32.

[3] Kocher, "Die Schilddrüsenfütterung im Lichte neuerer Behandlungsmethoden verschieden Kropf formen," *Correspondenzblatt f. Schweize Aerzte*, 1895, No. 1.

[4] Mikulicz, "Ueber Thymusfütterung b. Kropf u. Basedow'schen Krankheit," *Berl. klin. Woch.*, 1895, No. 16.

[5] Melzer, "On the Thyroid Therapy," *N. Y. Med. Journ.*, 1895, vol. i. p. 651.

[6] Naumann, *loc. cit.*

of mercury is said to have cured thousands of patients in India.[1] [2] The goitre is smeared with the ointment and exposed to the sun for several hours until it is blistered. Sometimes a single application suffices for a cure. Individually, no benefit has ever accrued from the employment of this latter remedy. Electricity, preferably in strong galvanic currents (60 milleampères), has in a few cases been of moderate service.

Injections.—The treatment of goitre by the injection of iodine or iodoform has given excellent results in the hands of a great many surgeons. Owing to the great improvement of the various operations for goitre, the number of cases treated by injection is not what it once was. There will always be patients, however, to whom it will be applicable, who are not suited to operation, or who refuse operation for cosmetic or other reasons.

Injections are the most applicable to the parenchymatous goitre in which there has been no great accumulation of colloid material, and in adenomata. These are the cases, it is true, which are also benefited by iodine internally.

The injected iodine—and probably the iodoform also—is in part absorbed and acts upon the system as ingested iodide does, though mainly it acts locally by setting up an inflammatory process, with formation of fibrous tissue and a subsequent shrinking of the area treated.

A moderate danger in its use lies in its possible injection into a blood-vessel. To avoid this the hollow needle is separately introduced, and if no blood escapes, the syringe is affixed and ten or fifteen drops of the tincture of iodine is slowly injected. Sometimes the treatment is followed by great pain under the jaw, extending up to the ear, and the patients state they can taste the injection, so rapidly is it absorbed. After two or three days, or later if there is a strong reaction, the injection is repeated. Sometimes improvement is very rapid, shrinking of the gland taking place in a few days. Generally ten to twenty or more injections are required.

The injections are to be given with the strictest aseptic precautions, else dangerous suppuration and abscess-formation, paralysis of the vocal cords, etc. may follow. Even at its best, the treatment is not without risk. Heymann[3] and Wölfler[4] mention 28 deaths; Schwalbe has estimated 1 death in a thousand injections as a result of embolism.

Solutions of iodine other than the tincture have been advocated, but have not been generally adopted.

Carbolic acid, arsenic, alcohol, and ergotine are less effectual than iodine, and are more hazardous.

Ferric chloride, chromic acid, and permanganate of potassium have now but few advocates. Among the novelties may be mentioned fluor, which in a watery solution, 1 : 200, has been used with success.[5]

[1] Mouat, "Goitre treated by Biniodide of Mercury," *Edin. Med. Journ.*, 1857, vol. iii. p. 595.

[2] Frodsham, "Du Traitement du Goître par les Applications topiques du Deutoiodure de Mercure," *Bull. d. Thérapeut.*, 1860, vol. lix. p. 57.

[3] Heymann, "Zur Jodbehandlung der Struma," *Verhand. d. 62 Versammlung. Deutsch. Naturforscher u. Aertze*, 1889.

[4] Garré, "Zur Kropfbehandlung m. parenchymatösen Einspritzungen," *Beit. z. klin. Chir.*, 1894, vol. xii. p. 321.

[5] Woakes, "The Pathogeny and Treatment of Bronchocele or Goitre," *Lancet*, 1881, vol. i. p. 448.

By far the most valuable substitute for iodine is iodoform. The use of this substance for injection in goitre was strongly advocated in 1890 by v. Mosetig[1] after a ten years' experience with it. He advised a mixture of iodoform, ether, and olive oil (1 : 5 : 9). By evaporation of the ether the iodoform is partly precipitated, and Garré[2] therefore recommends that the mixture have the proportion 1 : 7 : 7. The fluid must be kept in the dark. If it becomes brown, it contains free iodine and must not be used. With this mixture 140 cases were treated, about 15 minims of the fluid being injected every two to five days; from three to sixteen injections were required. Of 87 cases which could be followed, 77 (90 per cent.) were improved, and in all of them a decrease in the circumference of the neck was demonstrated. The reaction was in no case severe enough to make it necessary for the patient to go to bed. Occasionally there followed a local tingling or a slight pain in the ear or teeth, or dizziness, or a taste of iodoform for one or two days, but nothing more serious; so that the treatment may be described as *free from danger*.

In what way iodoform acts upon the tissues is not clearly understood. It is not considered that it produces its effect by inflammation and the formation of fibrous tissue. In animals[3] it develops a coagulation-necrosis when injected into the healthy thyroid gland.

Operative Treatment.—Of the twenty or more different operations which have been performed for goitre, four merit a detailed description. They are—partial resection, enucleation-resection, enucleation, and ligation of the thyroid arteries.

Extirpation of the whole gland has been generally abandoned, because of the danger that either tetanus or surgical myxœdema will result. The name "cachexia thyreopriva" is given to both of these conditions, of which tetanus is considered the acute and myxœdema the chronic form.[4] This variety of tetanus[5] begins with pain and twitching, usually in the arms and legs and later in the face. A sharp blow on a nerve-trunk, as the facial, or compression for a few minutes of an artery, as the bronchial, brings on a spasm in the part which it supplies.

In cases which progress to a fatal termination the spasms become general.

Tetanus may follow partial resection of the thyroid,[6] but this occurs rarely and in a light form. Hence the total extirpation of the thyroid except for malignant disease is looked upon as an unwarrantable operation. Thus, of 52 total thyroidectomies performed in Billroth's clinic[7] up to July, 1892, 12 were followed by tetanus: 8 of these cases died, and in 2 others the tetanus became chronic; of 12 cases of resection, where four-fifths of the gland was removed, 5 developed tetanus, but 4 of them recovered; of 47 cases, where at least one-

[1] v. Mosetig-Moorhof, "Der Behand. d. weichen Kropfes mit parenchym. Injection en v. Iodoform," *Wien med. Presse*, 1890, p. 1.

[2] Garré, *loc. cit.*

[3] Prins, "Ueber d. Einfluss d. Jods auf d. Schilddrüse," *Centralbl. f. Chir.*, 1895, No. 20, p. 483.

[4] Naumann, *loc. cit.*

[5] Weiss, "Ueber Tetanie," *Volkmann's Sammlung klin. Vorträg.*, No. 189 (*Inner. Med.*, No. 63), p. 1675.

[6] Zesas, "Weitere 50 Kropf excisionen," *Arch. f. klin. Chir.*, 1889, vol. xxxix. p. 526.

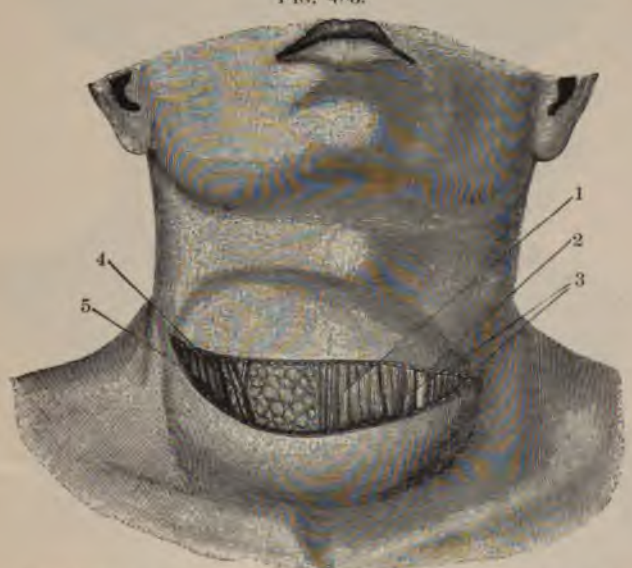
[7] Roux, "Operations de Goitres," *Congrès Franc. d. Chirurg.*, 1894, p. 51; v. Eiselberg, "Weitere Beiträge z. Lehre v. d. Folgezuständen d. Kropfoperationen," *Beit. z. Chir.*, 1892, Festschrift, p. 371.

fourth of the gland was left, 1 developed tetanus, and that in mild form. Experiments on animals give similar results. The Committee of the Clinical Society of London, which investigated the subject of myxœdema in 1888, found that cachexia thyreopriva in some form followed in 69 cases out of 255 upon whom total thyroidectomy had been performed; whereas it followed in only 6 cases of partial resection.

In the hands of skilful surgeons who have operated on many cases of goitre the mortality resulting therefrom has become insignificant—less than 1 per cent. But these results are obtained only after long experience and with the constant exercise of the greatest care. The proximity of the tumor to vital structures, the danger of sudden and profuse hemorrhage, the difficulty of preserving asepsis so near to the mouth, will always make the operation a serious one in spite of the most improved technique.

The skin should be prepared the day previous by shaving and the employment of antiseptic procedures with as much care as for a laparotomy, and the bowels thoroughly emptied in order to avoid for several days after the operation the congestion of the cervical veins attendant upon defecation. A small hard pillow under the shoulders allows the

FIG. 403.



Excision of a right-sided goitre by a transverse curved incision: 1, sterno-thyroid muscle; 2, anterior jugular vein; 3, sterno-hyoid muscle; 4, oblique communicating jugular vein; 5, sterno-mastoid muscle (from Kocher).

head to drop back and satisfactorily exposes the neck. Hemorrhage and injury to the recurrent laryngeal nerve are the accidents most to be guarded against. During the operation extra caution is needed to guard against infection from the mask or apparatus used for anæsthesia.

There is no agreement among surgeons as to the relative superiority of chloroform or ether in operations for goitre. Kocher's[1] experience

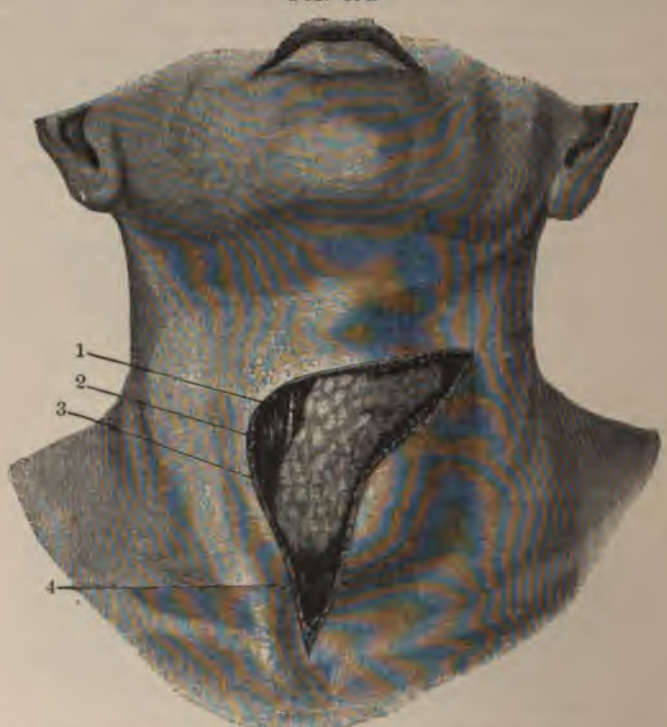
[1] Mikulicz, *loc. cit.*

is larger than that of any other operator, and he prefers chloroform or chloroform followed by small amounts of ether. In 900 operations he had no immediate death from the anæsthetic, and but one later, from an ether bronchitis.

Cocaine or a mixture of cocaine and morphine is much used by some Continental surgeons[1] in place of a general anæsthetic. After the skin-incision the pain is said to be slight. Kocher advises its use in all cases complicated with severe dyspnœa, and suggests that a further advantage in its use is the ability of the patient by speaking to demonstrate that the recurrent laryngeal nerve is not injured.

Partial Resection.—Billroth advocates an incision along the anterior edge of the sterno-mastoid muscle, but Kocher, in whose clinic for many years a record has been kept of the deformity which follows each opera-

FIG. 404.



Excision of a left-sided goitre (difficult case) by an angular incision: 1, anterior jugular vein; 2, sterno-hyoid muscle; 3, oblique communicating jugular vein; 4, inferior thyroid vessels (from Kocher).

tion, has decided that a transverse incision convex downward gives the best cosmetic effect (Fig. 403). The scar then simulates one of the natural wrinkles of the neck and is almost invisible. If the growth is a large one or its removal difficult, he makes use of an angular incision (Fig. 404) for similar reasons.

The following description is condensed from his *Operative Surgery*:[2]

[1] Roux, *loc. cit.*

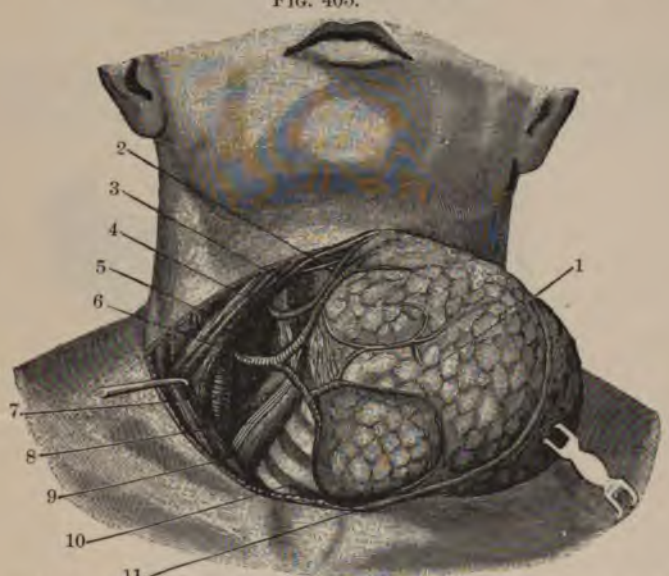
[2] Kocher, *Operative Surgery*, 2d ed., London, 1895.

A liberal *transverse incision*, curved downward, is made over the goitre. On the affected side it is prolonged upward and backward over the sterno-mastoid muscle. The skin and platysma are cut through, and the superficial veins are divided between ligatures. It is usually not necessary to destroy the external jugulars. Division of the fascia exposes the sterno-mastoid and sterno-laryngeal muscles. The latter are often spread out into a very thin layer. By cutting across the laryngeal muscles and nicking the anterior border of the sterno-mastoid the tumor is freely exposed.

The *angular incision* avoids the complete division of the sterno-laryngeal muscles. This incision is begun over the prominence of the sterno-mastoid muscle at the level of the thyroid cartilage. It is carried almost transversely—in the line of the creases of the skin—across to the middle of the neck, where it bends and passes vertically to the sternal notch. The superficial veins are ligated and divided as before. The anterior border of the sterno-mastoid is thoroughly freed, so that it may be drawn well to the side with blunt hooks. The sterno-thyroids and the sterno-hyoids are next clearly exposed, and their upper insertions, especially of the sterno-thyroids, are partially divided. These muscles are also drawn aside with blunt hooks, thus exposing the gland.

The subsequent steps are the same whichever incision may be chosen.

FIG. 405.

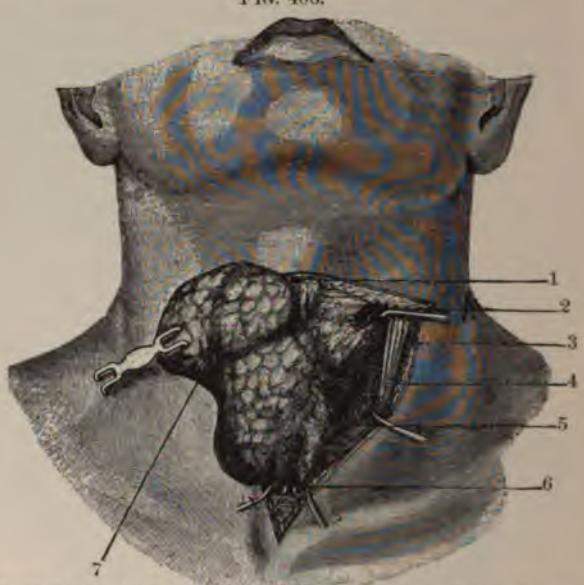


Excision of a right-sided goitre by a transverse curved incision; the goitre has been dislocated and rotated to the left: 1, right half of goitre turned toward the left; 2, superior thyroid artery and vein; 3, posterior border of thyroid cartilage; 4, sterno-hyoid and thyroid muscles; 5, sterno-mastoid muscle; 6, inferior thyroid artery; 7, right common carotid artery; 8, rec. laryngeal nerve; 9, œsophagus; 10, trachea; 11, inferior thyroid vein (from Kocher).

A thin layer of connective tissue—the *outer capsule* of the gland (but not the capsula propria)—is divided and reflected, all veins being ligated and divided, not torn through. (This dissection is spoken of by some surgeons as "intrafascial" or "bloodless" extirpation of the thyroid

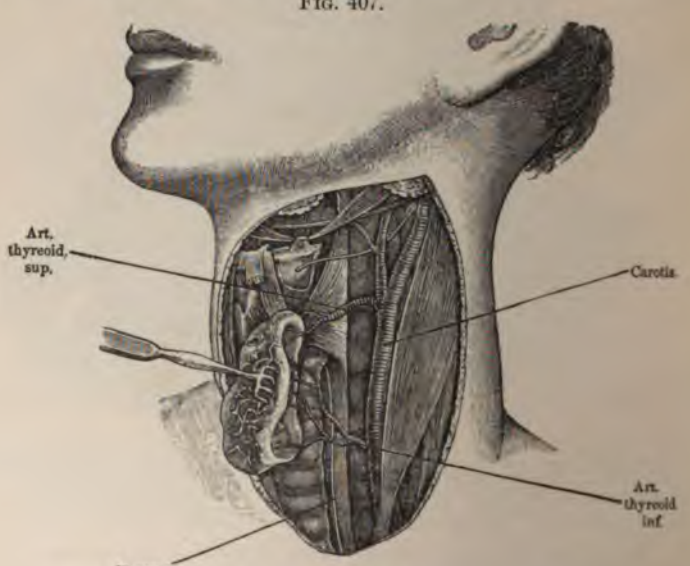
gland. In the retrosternal cases it is especially important to reach the capsula propria before attempting to dissect out the goitre.)

FIG. 406.



Excision of a left-sided goitre by the angular incision; dislocation of the goitre over to the sound side, and ligature of the main vessels: 1, vena thyroidea superior; 2, superior thyroid vessels; 3, sterno-mastoid muscle; 4, sterno-hyoid muscle; 5, inferior thyroid artery; 6, inferior thyroid vessels; 7, goitre dislocated and rotated upward over the trachea (from Kocher).

FIG. 407.



The relation of the recurrent nerve to the artery (from Wölfler).

The gland is next *dislocated forward* (Figs. 405 and 406), and the chief

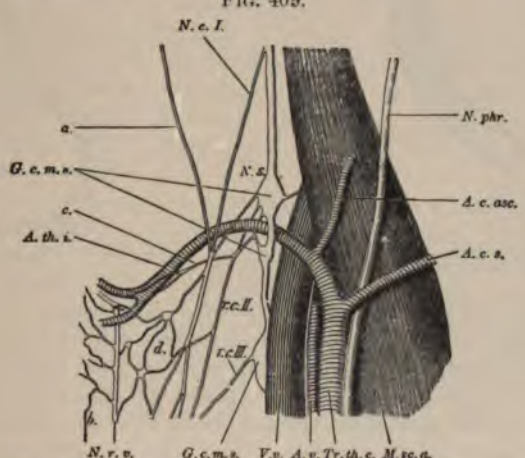
vessels are ligated. On account of the close relation of the recurrent laryngeal nerve, and particularly of the cardiac branches of the sympa-

FIG. 408.

Goitre seen from behind (from Kocher).

thetic nerve, to the inferior thyroid artery, the vessel must be seen to be separate from all tissue before a ligature or a clamp is applied. (Cf. Figs. 407, 408, and 409.) In difficult cases this part of the operation

FIG. 409.



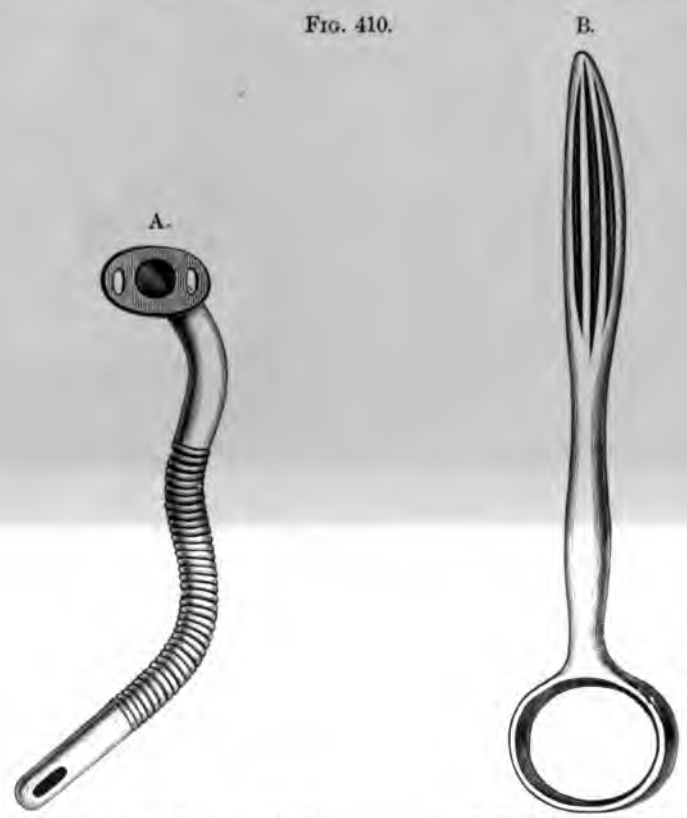
M.sc.a., scalenus anticus muscle; *Tr.th.c.*, *A.th.i.*, inferior thyroid artery; *A.v.*, vertebral artery; *V.v.*, internal jugular vein; *G.c.m.s.*, middle and inferior cervical ganglia; *N.c.I.*, *r.c.II.*, *r.c.III.*, cardiac nerves; *N.r.v.*, recurrent laryngeal nerve; *N.phr.*, phrenic nerve (from Drobnik).

may be left until the last. But, above all, no blind or hasty clamping of a bleeding point in this region is permissible.

The upper and lower horns of the thyroid are loosened by a blunt director from the capsule, lifted as far forward as possible, and the vessels ligated.

The superior and inferior communicating veins are doubly ligated and divided. A director and a strong silk ligature are then passed under the isthmus, and its tissue is cut through while the ligature is gradually drawn tight. For this purpose, as elsewhere in ligating the vessels, Kocher's grooved director (Fig. 410) is of service. The affected

FIG. 410.



A, König's long flexible tracheotomy-tube for goitrous dyspnœa.

B, Kocher's grooved director.

lobe of the thyroid is now free, excepting at its posterior surface. That is firmly attached to the trachea, and in its separation, despite every care, the recurrent laryngeal nerve may be injured. It is therefore thought better to cut through the tissue of the gland parallel to the surface of the trachea, leaving the posterior portion of it with its capsule as a protection against injury of this nerve. The small vessels are all tied, the divided muscles are generally sutured, and the wound closed with or without drainage.

If both sides of the thyroid are affected and demand removal, first one lobe, and then the other, must be drawn well forward and partially excised, so that bleeding shall be completely under control.

Enucleation.—Enucleation of the pathological nodule from the thyroid gland is an operation at least as old as Celsus. It is now associated with the name of Socin,[1] who brought it into general notice about ten years ago. The advantages claimed for it are the avoidance of resulting cachexia thyreopriva (myxœdema), also of injury to the recurrent laryngeal nerve, and the preservation of the normal contour of the neck. It is applicable to all non-inflamed cysts and adenomata, and also to goitres in which there is not a diffuse enlargement of the gland, such as is seen, for instance, in Graves' disease.

Keser[2] has shown that in most goitres are nodules surrounded by an easily recognizable envelope (the so-called "internal capsule," in distinction to the capsula propria), and that the nodules may be easily shelled out of the surrounding gland-tissue.

Previous treatment by injections or a suppurative thyroiditis makes enucleation very difficult. Recurrence is said to be no more common after enucleation than after other partial excisions.

Other surgeons do not completely agree with Socin and his assistants in regard to the value of enucleation. Kocher[3] admits that it is good for isolated cysts and solid tumors, but says that if it is employed upon a growing goitre, it is only a question of time when it will recur.

Bally[4] describes enucleation as performed by Socin as follows: The incision is made in the median line or over the outer border of the sterno-mastoid, according to the prominence of the tumor. If the tumor is very large or if both lobes of the thyroid are involved, Kocher's angular incision (Fig. 404) is employed.

The sterno-thyroid and sterno-hyoid muscles are split lengthwise and drawn aside. If the omo-hyoid cannot be drawn aside, it is cut transversely and afterward sutured. Incision into the sterno-mastoid is seldom necessary.

All bleeding points are secured and the tumor carefully inspected. If a nodule lies near the surface, its bluish-white envelope (the "internal capsule" of the gland described above) can be readily distinguished. Incision of the overlying atrophic granular tissue provokes but little bleeding, and the nodule is readily shelled out either with the finger or a blunt instrument. Its envelope is in most cases readily pulled out after it has been emptied.

If the nodule lies deeply imbedded in the gland, all vessels are secured and tied as the operator carefully cuts down upon it. Several nodules may often be reached through the opening made to remove the most prominent one. The hemorrhage is often copious, but can always be controlled with ligatures and compression.

Bose[5] uses an elastic ligature which is wound two or three times around the affected half of the gland after it has been lifted from its

[1] Garré, "Die Intraglandular Ausschälung d. Kropfknoten," *Centralbl. f. Chir.*, 1886, No. 45, p. 769.

[2] Keser, *L'énucléation de Goître parenchymatoux*, Paris, 1887.

[3] Kocher, "Ueber Weitere 250 Kropfextirpationen," *Correspondenzbl. f. Schweiz. Aerzte*, 1889, pp. 1, 33.

[4] Bally, "Beitrag. z. operativen Behandlung d. Kropfes," *Beit. z. klin. Chir.*, 1890, vol. vii. p. 509.

[5] Bose, "Die Künstlich Blutleere bei Ausschälung v. Kropfknoten," *Centralbl. f. Chir.*, 1889, p. 1.

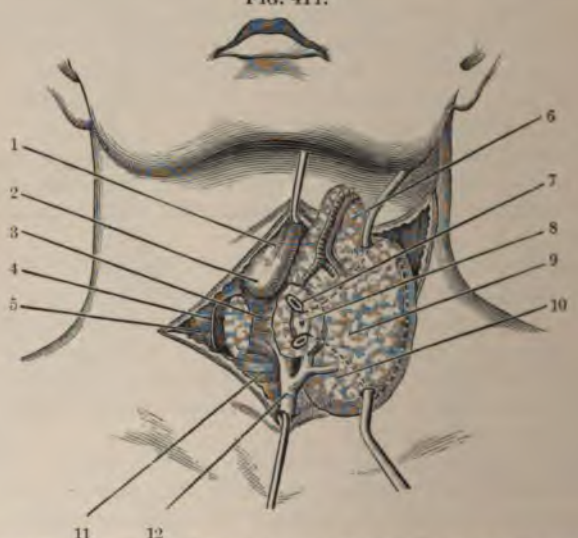
bed. The operation is then bloodless, and the dissection of the nodules is easily performed. After the removal of the ligature there is parenchymatous bleeding of very moderate amount.

The thin edges of the cavities in the gland are afterward trimmed away. A glass tube or gauze drain is inserted to the bottom of the wound, and the structures superficial to it are closed seriatim.

It will be noticed that Socin does not tie the thyroid arteries, and therefore avoids all danger of injury to the recurrent laryngeal nerve.

Enucleation-Resection.—Kocher has devised an operation for the removal of isolated nodules in a goitre which he calls enucleation-resection. It is performed as follows:[1] Either a transverse or an angular incision is made and the goitre is exposed and luxated as in resection, but without the ligation of the thyroid arteries. The isthmus is divided and his broad blunt multigrooved director (Kropf-sonde, Fig. 410) is passed through the cut surface to the nodule—usually a short distance. By means of this blunt director the attachments of the nodule to the gland-tissue lying in front of it are stripped up, and this gland-tissue is divided by an incision parallel to the trachea between two long ligatures. The posterior surface of the nodule is now freed and a second incision is also

FIG. 411.



Enucleation-resection: 1, thyroid cartilage; 2, cricoid cartilage; 3, posterior capsule of goitre; 4, ligatured isthmus; 5, healthy half of thyroid; 6, upper horn of thyroid; 7, cut surface of isthmus; 8, surface of nodule; 9, left lobe of thyroid; 10, posterior incision; 11, trachea; 12, inferior thyroid vein (from Kocher).

made through the gland-tissue nearer the median line (Fig. 411). The nodule and that part of the thyroid lying in front of it—elliptical in shape—are now removed and the wound closed.

Ligation of the Thyroid Arteries.—Ligation of the thyroid arteries is followed by glandular anæmia, with secondary obliteration of vessels and atrophy of cellular and fibrous structures of the gland.[2]

[1] Kocher, *loc. cit.*

[2] Wölfler, "Ueber d. Effekt nach Unterbindung d. Arteriæ thyreoideæ bein Kropf," *Verhand. d. Deutsch. Gesellschaft f. Chirurg.*, 1887.

To Wölfler[1] is due the credit of bringing into prominence this method of treatment. He advocated it only in benignant growths and in cases not suited for enucleation.

Billroth[2] and Rydygier[3] advise ligation of the four arteries at once—not fearing cachexia thyreopriva (myxœdema), as the atrophy is a gradual one. Kocher[4] prefers resection of the tumors except in vascular goitre, as in Graves' disease. He considers it wrong to ligate more than three arteries.[5] Trendelenburg[6] ties the arteries of one side, and four weeks later those of the other side.

In order to apply a ligature to the *superior thyroid artery* an incision is made along the anterior border of the sterno-mastoid muscle. The artery is found in a triangle whose base is the hyoid bone and whose sides are the carotid artery and the outer margin of the omo-hyoid muscle. The artery is most accessible about an inch below the hyoid bone.

Ligation of the inferior thyroid artery is more difficult, and several methods of reaching it have been proposed.

Kocher[7] makes his incision along the inner border of the sterno-mastoid and down to the capsula propria of the thyroid gland, tying all veins. The gland is drawn to the other side, and the artery is readily found behind the carotid, lying in a horizontal position in front of the longus colli muscle. If it is tied in this situation, the cardiac sympathetic nerve lies at a safe distance to the outer side and the recurrent laryngeal to the inner side. The artery can scarcely be confounded with the vertebral, but it may be so enlarged, especially in Graves' disease, that it may resemble, except in its direction, the carotid artery.

Rydygier's[8] method is to make a transverse incision three inches in length parallel to and one inch above the clavicle, so situated that more than half of the incision lies posterior to the sterno-mastoid muscle. After division of the superficial structures the space between the sterno-mastoid and scalenus anticus is thoroughly opened up with the fingers. When this is accomplished it is possible to lift forward and inward the sterno-mastoid, carotid artery, and vagus nerve without separating them, and to expose the thyroid axis.

With long dissecting forceps the inferior thyroid can now be separated, and tied either with a single ligature or doubly ligated and divided. The transverse incision makes the operation easier than a longitudinal one, and leaves less scar.

Thyreoidechthesis.—Jaboulay[9] has performed a few times an operation which he calls *thyreoidechthesis* or *exothyreopexy*. It consists in freeing the gland, and leaving it to granulate in the wound under aseptic dressing. The treatment is bloodless, and is said to produce atrophy,

[1] Wölfler, "Die Operative Behand. d. Kropfes durch. Unterbindung d. Zuführenden Arterien," *Wien. med. Woch.*, 1886, vol. xxxvi. pp. 1013-1052.

[2] Billroth, "Ueber d. Ligater d. Schilddrüsenarterien behufs Einleitung d. Atrophie d. Kropfen," *Wien. klin. Woch.*, 1888, vol. i. p. 3.

[3] Rydygier, "Zur Behandlung d. Kropfes durch. Unterbindung d. Zuführenden Arterien," *Wien. med. Woch.*, 1888, vol. xxxviii. pp. 1635, 1665.

[4] Kocher, *loc. cit.*

[5] Mikulicz, *loc. cit.*

[6] *Ibid.*

[7] Kocher, *loc. cit.*

[8] Rydygier, "Zur Operationstechnik bei d. Unterbindung d. Arteria thyreoidea inferior," *Centralbl. f. Chir.*, 1889, p. 241.

[9] Gérard, "Operation d. Jaboulay, Thèse de Lyon," *Centralbl. f. Chirurg.*, 1894, No. 32, pp. 758 and 766.

with consequent benefit. It is especially recommended by its author in parenchymatous cases with symptoms of dyspnœa.

One fatal case has already occurred, death following in some hours an apparently successful operation. Brissaud, who reported the case, attributed the death to iodoform-poisoning.

Results of Operation.—The mortality from operations upon goitre has steadily decreased, partly, no doubt, because formerly only desperate cases came to operation, partly because of improvement in the operations now in vogue.

In a paper presented to the Congress of German Surgeons in 1883, Kocher[1] placed the mortality from the 70 operations which were reported before 1850 at 40 per cent. From that time until 1877, 146 operations had a mortality of 21 per cent., while for the six years previous to the report 240 operations had a mortality of 11 per cent. Since that time individual surgeons have reported much more favorable results.

Of 62 cases operated on in Albert's clinic before 1891, 1 died.[2]

Roux[3] in 1894 reported a mortality of 1.36 per cent. in 292 operations.

Kocher[4] in 1895 placed on record nearly 900 cases of benign goitre which he had operated on, with a mortality of about 1 per cent.

Zesas[5] lost 1 case in 50 operations, and that from pneumonia.

Krönlein's[6] last 200 operative cases all recovered.

Sulzer[7] in 1893 reported 144 operations on benign goitre, with no fatal results.

The cause of death from operation is various. Patients have died on the table from chloroform or collapse, as in other operations, and from air-embolism. Twisting of an atrophic trachea has caused death at the time of operation. Œdema of the lungs and broncho-pneumonia, especially when it has been necessary to perform tracheotomy, have caused many of the recorded fatalities. Suppurative mediastinitis may be rapidly fatal, death ensuing sometimes as early as the second day. This gives no local symptom except pain under the sternum, increased by pressure, and is likely to be overlooked. Acute tetanus has already been mentioned. It is rarely seen after complete extirpation of the thyroid, and it has been successfully treated by thyroid extract. It is also important in this complication to keep up the temperature of the body by external heat. Acute sepsis with a temperature running to 106° and 107° has been encountered in two instances of partial resection at the New York Hospital, with a fatal result within twenty-four hours after operation. As, however, the wounds presented a normal appearance at the autopsy, the question of a special thyroid infection was raised in explanation of this result.

When we turn to the complications which follow operation, the

[1] Kocher, "Ueber Kropfextirpation u. ihre Folgen," *Verhand. d. Deutsch. Gesellsch. f. Chirurg.*, Berlin, 1883, vol. xii. p. 1.

[2] Lehotzky, "62 Fälle v. Kropfenucleationen," *Wien. klin. Woch.*, 1891, vol. iv. pp. 755, 786. [3] Roux, *loc. cit.* [4] Mikulicz, *loc. cit.* [5] Zesas, *loc. cit.*

[6] Krönlein, "Klinische untersuch. üb. Kropf, Kropfoperationen, und Kropftod," *Beit. z. klin. Chir.*, 1892, vol. ix. p. 577.

[7] Sulzer, "Bericht üb. 200 Kropfoperationen," *Deut. Zeit. f. Chir.*, 1893, vol. xxxvi. p. 199.

improvement in results is nearly as marked as the mortality. Partial or complete paralysis of one vocal cord was a common sequence of early operations. The reports on this point are usually not as full as one could wish, but Krönlein[1] in 1892 stated that of 101 cases upon which he had operated, and which he had been able to trace, total paralysis of one cord existed 18 times. In 5 of these patients total paralysis was present before operation, and in some others there was hoarseness. In Zesas's last 50 cases there was no paralysis resulting from the operation.[2]

Malignant Tumors.

Carcinoma and sarcoma of the thyroid gland must be counted among the rarer tumors. The former is less rare than the latter. In 18,147 autopsies made in Vienna,[3] carcinoma occurred in various situations 1869 times. In 2.6 per cent. of the carcinomatous cases the disease was situated in the thyroid gland. In Czerny's clinic,[4] from 1878 to 1888, 809 cases of goitre were treated, 31 being malignant—3.8 per cent.

Most cases of malignant disease develop in a pre-existing goitre in patients from forty to sixty years of age. Lancinating pains, rapid compression of the œsophagus, and dyspnœa are the most characteristic symptoms. Hardness and the comparatively small size of the growth are also signs suggestive of carcinoma.

For a **differential diagnosis** between malignant and benign goitre the position of the cervical vessels may be of importance. A benign tumor, if of sufficient size, pushes them before it—a malignant one grows about them. Of more value is the infiltration of the surrounding tissues, which often prevents a malignant growth from moving upward in swallowing. It must also be remembered that a carcinoma not of thyroid origin may also become adherent to the trachea and thus simulate a thyroid growth.

The **prognosis** in this disease is bad. The average duration of life in cancer of the thyroid is, according to Orcel,[5] only six months. There are, however, certain forms of sarcoma and of adeno-carcinoma which stand on the border-ground of malignancy, and which do not pursue this rapid course. Barker[6] successfully removed such a tumor which had existed for six years. Two years later a recurrence was removed, and four years later there was no further recurrence.

Excision of a carcinomatous thyroid is an operation of great difficulty. The external appearance of the tumor is untrustworthy evidence of its extent, and it is often necessary unexpectedly to excise portions of the larynx, trachea, œsophagus, or cervical vessels or nerves in order thoroughly to remove the disease. Death from broncho-pneumonia in such cases is very common.

Some surgeons[7] have expressed themselves against any attempt at radical operation in cancer of the thyroid, and the results formerly ob-

[1] Krönlein, *loc. cit.* [2] Zesas, *loc. cit.*

[3] Hinterstosser, "Beitrag z. Lehre von Schilddrüsenkrebs," *Beit. z. klin. Chir.*, 1892, Festsch., p. 287.

[4] Hochgesand, "Die Kropfoperationen, Heidelberg, 1878–88." *Beit. z. klin. Chir.*, 1890, vol. vi. p. 647.

[5] Orcel, "Du Cancer du Corps thyroid," *La Provence Méd.*, Lyon, 1889.

[6] Barker, "Treatment of Tumors of the Thyroid," *Brit. Med. Journ.*, 1895, vol. ii. p. 905.

[7] Symonds, "Treatment of Tumors of the Thyroid," *Ibid.*, p. 904.

tained almost countenance this view. It has been estimated[1] that 60 per cent. of the operated cases die in eight weeks, and 84 per cent. in six weeks. There are reported, however, undoubted cures after operation.

Exophthalmic Goitre (Graves' or Basedow's Disease).

Though this affection is generally and properly treated as a medical one, a few words concerning its surgical relations will not be out of place here.

The evidence is increasing that a reduction in the size of the thyroid has a beneficial effect on the general symptoms of tachycardia, nervousness, and tremor, which in the main characterize this disease.

Mikulicz[2] says that it is immaterial how this reduction in size is obtained—whether by resection or enucleation or incision of cysts, or by ligation of the thyroid arteries—that the result is the same.

The benefit accruing from the operation is not simply a mechanical one due to the relief of a pressure on the trachea or sympathetic nerves, for equally good results have followed operation where no such pressure existed.

Many theories have been brought forward to explain the origin of Graves' disease. Two are especially interesting in connection with the facts above mentioned.

Moebius[3] was of the opinion that this form of goitre is due to an auto-intoxication from hypersecretion of the thyroid gland. The removal of a part of the gland is said, therefore, to correct this hypersecretion, and so cure the disease. This theory has the merit of simplicity, but it does not explain all the facts.

Those who regard the lesions of the thyroid primary,[4] and the general symptoms secondary to them, are decidedly in the minority. Mikulicz[5] holds to the idea that Graves' disease is a psycho-neurosis which may exist without thyroid enlargement. If the latter is present, it acts in a twofold way—to aggravate the symptoms by auto-inoculation, as Moebius says, and as a "multiplier" of the circulatory disturbances. For a further discussion of this interesting question the reader is referred to the original article.[6]

Be the origin of the disease what it may, it still remains true that in many cases, if a considerable portion of the thyroid is removed, the disease either undergoes spontaneous cure or yields more readily to internal remedies. The improvement following the operation is often a progressive one, occupying a year or more for its completion, though the exophthalmus may remain permanently after all other symptoms have disappeared.

The mortality of such cases treated without operation is variously estimated[7] at from 9 to 50 per cent., but this depends more on the circumstances and care of the patient than on the disease itself.

[1] Rotter, "Die operative Behand. des Kropfes," *Arch. f. klin. Chir.*, 1884–85, vol. xxxi. p. 683.

[2] Mikulicz, *loc. cit.*

[3] Moebius, *Deut. Zeit. f. Nervenheilkünde*, 1891, Bd. i.

[4] Greenfield, "Diseases of the Thyroid Gland," *Lancet*, 1893, vol. ii. pp. 1493 and 1553.

[5] Mikulicz, *loc. cit.*

[6] *Ibid.*

[7] Pribram, "Zur Prognose d. Morbus Basedowii," *Wien. klin. Rundschau*, 1895, No. 1.

Herskind[1] collected 53 cases treated by operation. Of this number, 17 (40 per cent.) were reported cured; in 6 cases (11 per cent.) exophthalmos persisted, all other symptoms being relieved; in 11 cases (21 per cent.) there was improvement of symptoms; 3 cases were unimproved; and 3 died from the operation. Starr[2] reports the results of operation in 190 cases of exophthalmic goitre collected by him, as follows: Cured, 74; improved, 45; unimproved, 3; died from operation, 23—a mortality of about 12 per cent. He considers death in such cases to be due to the absorption of an increased or altered secretion of the thyroid gland, which follows the operative manipulation, and cites in support of this theory the fact that the simple examination of the thyroid in a patient suffering from exophthalmic goitre usually brings on an increased nervous excitability and quickened heart-beat. He recommends medicinal treatment and, if that fails, operation.

Kinnicutt[3] has published a table of 187 operative cases of Graves' disease, with but 13 deaths (7 per cent.). Of the remaining cases, 60 were reported by the various operators as having recovered, 47 were improved, 11 unimproved, and in 25 instances the result is not given.

Thyroid-therapy has also been employed in the treatment of exophthalmic goitre, but the results as reported are conflicting, and a larger observation on this point is needed before its value can be finally determined. Present belief would judge this remedy to be contra-indicated.

[1] Herskind, "Die Chirurg. Behandlung u. d. Pathogenese d. Morbus Basedowii," *Centralbl. f. Chir.*, 1895, p. 393.

[2] Starr, "Exophthalmic Goitre," *Med. News*, 1896, vol. i. p. 421.

[3] Kinnicutt, "Thyroid Origin of Graves' Disease and its Surgical Treatment," *N. Y. Med. Record*, Apr. 18, 1896.

THE SURGICAL PECULIARITIES OF THE NEGRO.

By RUDOLPH MATAS, M. D.

Historical and Other Preliminary Considerations.

With few exceptions all the negroes on the American Continent are directly descended from the black slaves imported from Africa during the slave-trade. The origin of the negro in the United States dates back to August, 1619, when a Dutch ship entered the James River and landed a cargo of African slaves in the colony of Virginia. They were purchased by the colonists, and they and their offspring were held in perpetual servitude. Thus at Jamestown, twelve years from the settlement of the colony of Virginia and one year before the Pilgrim Fathers had touched the New World, began that system in the British continental colonies which under the fostering care of England overspread the land. During the years from 1619 to the opening of the American Revolution (1776) more than three hundred thousand African bondsmen were imported into the thirteen English colonies. In 1864, at the close of the Civil War, the negro population had increased to 4,000,000, and now, according to the census of 1890 (or two hundred and seventy-one years after their first introduction to this country), the black and mixed or mulatto population has increased to 7,470,000.

In consequence of the diversity of the populations that inhabit the vast territorial area which furnished the material for the negro traffic many varieties of negroes were introduced into the American colonies. These varieties were readily recognized by the colonists, and their physical and mental characteristics furnished a basis for differential quotation in the slave-market. Different prices were asked for the Senegalese, Yoloff, Bambara, Mandinga, Congo, Guinea, Arada, Caffre, and other slaves, because these were known to possess certain qualities, as the case might be, which made them desirable or undesirable to the purchasers. In the course of time it naturally happened that these distinctly differentiated types were gradually forced into fusion, and that a more homogeneous but new entity resulted from the amalgamation. Hence it may be said that the typical American negro of the present generation is a truly composite type which has incorporated in its formation all the generic characteristics of the West African tribes. It is not probable that the ethnic differences between these varieties of negroes were of a fundamental or generic character, as all the slaves imported from the

West Coast of Africa were, as a rule, individuals presenting the essential characteristics of the typical negro race.

While it must be admitted that the American negro, as he is known to-day, is a composite type formed by the fusion of many distinct sub-types of black men, it is still claimed that in the United States some of the original sub-types can be recognized. A recent Southern writer, Otken,[1] accepting the classification of other authorities, says: "We have in the United States the Guinea negro, the Yoloffs, and the Caffres; to these must be added those in whose veins flow one-half, three-fourths, or seven-eighths white blood, or the mulattoes, quadroons, and the octoroons (the last three are designated usually by the common title mulatto). These four classes are found on American soil." The Guinea negroes constitute an overwhelming majority. They are characterized by their woolly hair and black skin, thick lips, a broad, flat nose, prognathous jaws, narrow and receding forehead, a slender waist, high hips, slender limbs, and massive feet rounded on the bottom. The close observer may have seen a few Yoloffs and Caffres. The Yoloffs, in addition to woolly hair and jet-black skin, possess fine forms and strictly European features. The Caffres are of woolly hair, blackish-brown complexion, and have fine forms and features. The Yoloffs and Caffres may constitute from 5 to 10 per cent. of the pure African race in the United States.

The Mulatto.—From every point of view, but especially from the anthropological, physiological, and pathological, it is certain that the most important modifying influence that is to be considered in the study of the African in this country is the effect of the infusion of white or Aryan blood into the original pure negro type. This modifying influence, as exhibited in the various mixed-breed products—the various degrees of the mulatto type previously referred to—is proportional to the amount of blood of either race that enters into the composition of the individual. The mulatto offspring of typical white and black parents usually presents the external and recognizable characteristics of both races in nearly equal proportions. The modifying influence of mixed blood is, however, even more profound than the external appearances indicate, and produces results independent of the parent characteristics. Unfortunately, reliable data are wanting, but the almost unanimous verdict of those who are best authorized to speak on this point would lead us to accept as a fact that which we have only the right to consider an impression—namely, that mulattoes, and especially those that result from the crossing of the pale, blonde Aryan type with the negro, have not the strength and endurance of either of the two races. It is certain that they are much more liable to certain diseases, especially to tuberculosis and syphillis. It is almost certain that when they marry among themselves the next generation is even still feebler; and it is probable that in a few generations they would die out unless reinforced by the stronger blood of the pure races, in which case, of course, they disappear by absorption into one race or the other. In intellect the mulatto is certainly superior to the negro, but it is doubtful whether the white blood does not lose more than the negro gains by the admixture. These conclusions have been reached by nearly all ob-

[1] C. H. Otken, *The Ills of the South*, Putnams, New York, 1894.

servers; as, for example, by Morton, Nott, Gliddon, Gobineau, Ferrier, and others. The only prominent exception is that of Quatrefages, who contests them (Le Conte).

A modifying influence of great importance in the comparative pathology of the negro, as well as of other races, is that due to the action of the environment. The transportation of the negro from the torrid regions of the Senegal, the Niger, and the Congo to the temperate climate of North America, together with the effect of a sudden transition from the primitive or savage state to the complex conditions of civilization, must have been productive of marked alterations in the physical constitution of these people. The accumulated evidence that has been gathered during the nearly three hundred years that this race has inhabited the North American continent clearly confirms this induction. One of the first noticeable effects of this change was the gradual elimination of certain diseases which were peculiar to Africa and which were imported by the slaves to this country. The best-known and most formidable of these were yaws, the sleeping sickness or African cachexia, and the various forms of elephantiasis, all of which were very prominent in the days of the slave-trade, but have since become practically extinct in the United States, though still endemic in the Antilles and other regions of our continent in which tropical conditions have permitted these diseases to retain a permanent foothold. On the other hand, the comparative immunity enjoyed by the race against certain diseases, and which was most marked in the earlier days of their history in this country, has been impaired by their prolonged residence and their new habitat. Thus malaria, which at one time rarely attacked the negro, has gradually become more common among them, and almost to the extent known among the white population. It is probable that dysentery, gastro-intestinal diseases in general, hepatic inflammation, and certain diathetic affections—*e. g.* rheumatism and gout—are types of diseases which at one time were practically unknown to this race, but which now, owing to the altered conditions of the environment, have become firmly affixed to their pathology. But the influence of the environment and of forced cohabitation with the white race are nowhere better displayed than in the frightful tribute that the colored race has had to pay to the great pests of Aryan civilization—tuberculosis, syphilis, and cancer. These fatal diseases, as will be shown later in the text, appear to be rapidly increasing among them, so that it is a serious question whether the intellectual progress accomplished by the negro under the tutorship of the white man is not being rapidly neutralized by the deteriorating influences of civilization upon the physical organization of a race that is not adequately prepared for it.

Anatomical Peculiarities.—The gross external differences which are revealed to the eye when typical individuals of the white and negro race are contrasted are too familiar to be detailed here. But, in addition to the differences which are so vividly recognized by the most careless observer, there are numerous characters which distinguish the negro from other races, and which, to the comparative anatomist, the anthropologist, the evolutionist, and philosopher, are profoundly interesting and significant. Most of these characters tend to confirm the lowly status of the negro in the scale of human evolution, and to establish

closer analogies with the anthropoids than exist between these and other races of mankind.

But, no matter how interesting these peculiarities may be to the philosopher, they have no place in the study of the race from the clinical point of view. Indeed, when the negro is dissected by the scalpel of the practical anatomist the numerous and important differences in structure referred to sink into comparative insignificance, and we are compelled to admit that there is little to be learned by the dissection of the black man that is worthy of special remembrance in the operating-room. Some peculiarities in the organization of the negro have been noticed by practical men which have a distinct application at the bedside, but these have a far greater bearing upon the interpretation of pathological phenomena than in the modification of operative procedures. As students purely interested in the application of anatomical modifications due to race-variation to the problems of the surgical art, we can safely assert that the negro presents no peculiarities that are of practical consequence, and that the operations of surgery that are based upon the anatomy of the white man are in every particular applicable to the black race. If it is granted that this appreciation of the comparative anatomy of the negro from the surgeon's point of view is true, we will be excused from attempting a long recital of the comparative anatomical data that have been stored up by anthropologists. It will, however, increase our familiarity with the race, and especially with its pathological peculiarities, to review, if only in a cursory and synoptical manner, the more salient anatomical and physiological features that are of general interest to the surgeon.

Leaving out of consideration the exceedingly interesting differences in the skull that distinguish the negro from other races, and which anthropological research has centred in the total cranial capacity, in the cranial index, in the facial angle, in the precocious ossification of the sutures, in its prognathism, and other numerous characteristics of minor importance, we shall note simply that the average skull of the negro is, as a whole, not only smaller, but, what is more interesting to the surgeon, unquestionably thicker, than that of the average white. Herodotus mentions the greater hardness of Ethiopian skulls, proving in that respect, at least, that the negro is the same now that he was over two thousand years ago. This point has some bearing on the operation of trephining or performing osteoplastic resections of the skull in this race. The tables are denser and thicker, and the diploic layer correspondingly larger. The study of cranio-cerebral topography from the standpoint of localization is especially interesting in this connection, but we shall reserve its consideration for a later moment. In examining the head for other points of surgical application we find that the recent studies of American specialists in eye, ear, nose, and throat diseases have resulted in obtaining a few facts of practical application.

The most important anatomical peculiarity of the negro eye is the intense pigmentation of the uveal tract, including in this the iris and the ciliary body. It is worthy of notice that these tissues are the most violently attacked in diseases of the eye in this race. The normal proportions of the diseases which attack this region is stated at about 20 per cent. of the ophthalmic affections which prevail among the white popula-

tion in New Orleans. This rate is surpassed by more than 11 per cent. in the negroes, according to the statistical evidence furnished by Dr. Bruns.[1] As suggested by this observer, the embryological and histological connection between the choroidal tissues and the highly developed and functionally very active skin of the negro may be not wholly devoid of influence.

The functional condition of the eye of the negro contrasts most favorably with that of the white. Refractive errors are rare (only 6 myopic individuals in a clinic of 1113 negro eye cases). But this is in consonance with all that experience and reason teach us. Refractive defects are among the taxes laid by advancing civilization upon mankind. The more sedentary, cerebral, and ocular become the conditions of existence, the greater the advance in ophthalmic science and the larger grows the army of spectacle-wearers. As the negro advances in civilization he will be called upon to bear its physical as well as its other burdens (Bruns).

The Ear.—Notwithstanding Burmeister's assertion to the contrary, the auricle of the negro, instead of projecting from the sides of the head, appears flatter and in closer contact with the skull, and the auditory canal is straighter and larger, than in the white—so much so that in a fully-developed African adult the canal will almost admit of the little finger. The canal is so straight and large that, according to otologists who are well qualified to speak on the subject (Murrell,[2] De Roaldes,[3] and Scheppegrell),[4] the ear speculum is seldom required to view the drum-membrane. In fact, the peculiar straightness of the auditory canal in the negro is so strongly typical that it is one of the last traits to be lost in approximating the Caucasian type, and for this reason it is noticeable in nearly all mulattoes (Murrell). The canal is also of slightly shorter average depth than in the white, as would be inferred from smaller transverse measurement of the negro skull.

No comparative studies of the middle or internal ear have been made. The mastoid process is usually quite small, and presents less cell-surface within than is common with the white adult, while the hard or cortical exterior, like the calvarium, is generally excessively thick. It has also been observed that the sinuses about the face of the negro are much smaller in dimensions than in the white race, and are protected by a much thicker bony casing, which is in harmony with the general morphological tendency of the skull in this race. The Eustachian tubes open into an extremely wide and capacious pharynx opposite very broad and unobstructed posterior nasal meati. The pharynx is peculiarly roomy; the tonsils are rarely enlarged, and seldom encroach upon the broad span of the fauces. The cavity of the mouth and the length of the palate are proportional in length to the prognathous projection of the jaws.

[1] Dr. H. D. Bruns, *Fourth Annual Report Eye, Ear, Nose, and Throat Hospital of New Orleans;* also, "Two Years in a Southern Eye Clinic," *Trans. La. Ital. Med. Soc.*, 1895.

[2] Dr. T. E. Murrell, "Peculiarities in the Structure and Diseases of the Negro," vol. iii., *Transactions Ninth Int. Medical Congress*, Washington, D. C.

[3] Dr. A. W. De Roaldes, *Proceedings Fifth Int. Congress of Otology*, Florence, Sept., 1895, "A Preliminary Note on Some of the Otological Peculiarities of the Negro."

[4] Dr. W. Scheppegrell, "The Comparative Pathology of the Negro in Diseases of the Ear, Nose, and Throat, from an Analysis of 11,855 Cases," *Proceedings Orleans Parish Medical Society*, New Orleans, La., Aug., 1895.

The Nose.—The nose of the negro gains in width at the expense of its projection. Its base is large and crushed in, owing to the softness of the cartilages. It is spread out in two divergent alæ with the elliptical nostrils more or less exposed. The septum is rarely deflected, contrasting in this respect with the septum of the white, which is seldom free from deviation or other abnormality. The greater breadth of the inferior meati corresponds with the larger aperture of the choanæ and allows of unobstructed ventilation. This corresponds with the greater breadth of the nasal openings in the skeleton, which gives to the negro skull its typical platyrrhinian character. It has been claimed that the turbinated bones are more developed, and that the mucous membrane is thicker and more sensitive, but this is a mere impression which needs confirmation.

The peculiarities referred to in connection with the ear, nose, and throat are of interest in practice, because, owing to the larger size of the apertures and spaces, their examination is much simplified in individuals of this race. In addition to the greater ease with which the auditory canal and drum-membrane are explored, the larger size of the canal may account for the comparative rarity of waxy accumulations and for the diminished frequency of other ear diseases which are relatively more common in the white race. The larger size of the nasal chambers would probably account, by the great ventilation of the nasopharynx, for the relative immunity of the negro from post-nasal catarrh, adenoids, and other affections of this region, which are certainly more prevalent among the whites (De Roaldes, Scheppegrell, *et al.*).

Other anatomical peculiarities of the skeleton that are frequently referred to by anthropologists, but which have little or no surgical application, are the following: The three curves of the spine are less pronounced in the negro; the thorax is flatter from side to side; the iliac bones are thicker and more vertical; the antero-posterior diameter of the pelvis is increased; the neck of the femur is set at a less oblique angle; a third trochanter probably occurs more often than in the white; the tibia is more curved and shows a greater tendency to lateral flattening; the upper limb is longer, owing to the relatively greater elongation of the radius and ulna; the foot and hand are longer as a whole than in the white man. The calcaneum is longer and projects farther backward. A tendency to flat-foot is normal. The axial rotation of the humerus is greater. The linea aspera of the femur, the clavicle, and the scapula, etc. present peculiarities which give to the skeleton a greater analogy with the simian skeleton than in the white race.

Cranio-cerebral Topography.—The relations of the brain to the overlying skull-covering offer no specially important racial distinctions in practice. The writer has repeatedly outlined the great fissures of the cortex of the brain on the skull in both negro and white subjects with the help of Wilson's cyrtometer, Champonnière's rule, Horsley's, Anderson's, and Makins', and other methods. By none of these procedures has he found any difference between the negro and the white that was worthy of notice. These comparative examinations have been made annually from 1886 to 1894 while demonstrating the methods of cortical localization on the skull to classes in Tulane University and in the New Orleans Polyclinic. In the living negro I have also had occasion

to test the value of cranio-cerebral topography in three cases presenting focal symptoms (two cases of abscess and one of meningeal hemorrhage), and in no case was there any difficulty in exploring the desired areas by one of the classical methods referred to. I therefore believe that from a surgical point of view the brain of the negro in relation with its osseous covering presents no racial variations which are worthy of special consideration in the operating-room.

The Vascular System.—Considered as a whole, the vascular system of the black as compared with the white presents no differences that are of surgical interest. According to Pruner Bey, the venous system predominates visibly over the arterial. My personal impression, based upon the observation of several hundred subjects in the anatomical laboratory, would lead me to accept in a general way the correctness of Pruner's observation as regards the venous system. In fact, my experience is diametrically opposed to that of Cartwright of New Orleans, who in 1852[1] stated that the negroes were difficult to bleed, owing to the smallness of their veins. My experience does not bear out the assertion that on cording the arm of the stoutest negro adult "the veins will be found scarcely as large as those of a white boy of ten years."

Bearing in mind the statement that has been made by a distinguished American anatomist, that anomalies of the arterial system were more frequent in the negro than in white subjects, I have been careful in my experience in the dissecting-room to observe the peculiarities of the arterial distribution in the numerous negro subjects that came under my observation, and, while I have not been able to accumulate a sufficient number of recorded observations for the purpose of a statistical study, I am convinced that, while arterial anomalies are indeed very frequent in the negro, they are not at all characteristic or racially specific. I am not prepared to admit that they are more frequent, as Professor Keen has asserted. My impression is that they are not more frequent, and, if they are, their relative differences must be so slight that they cannot be considered of surgical consequence.

Muscular System.—In view of the important and interesting results that have been obtained in the study of muscular anomalies by comparative anatomists, and of the success that has attended the interpretation of these anomalies by the application of evolutionary doctrines, especially the theory of atavism or reversion of type to ancestral animal forms, it is natural that much curiosity should have been felt by anatomists as to the peculiarities of the muscular system of the negro in this respect. Cuvier was probably the first to investigate the myology of the negro in a philosophic spirit, but since the publication of his *Atlas of Comparative Anatomy* in 1849 many of the most competent and authorized anatomists have followed in his footsteps. It is to be regretted, however, that the reports of the dissections of the negro that have been published have been made by observers unfavorably situated for a large collective investigation of the subject. As a result, the conclusions derived from their dissections refer purely to variations found in individual subjects, and lack the weight and significance which would be attached to the analysis of the muscular anomalies found in large groups.

[1] S. Cartwright, "Diseases and Physical Peculiarities of the Negro Race," *N. O. Medical and Surgical Journ.*, May, 1852.

Nevertheless, as a result of a careful dissection of negroes reported by Wood, Pye-Smith and Phillips, Murie, Flower, Turner, Hamy, Chudzinski, Giacomini, and Testut, it has been proven that the negro is subject to many anomalies of the muscular system. In this country Baker, Michel, Matas, and others confirm the existence of these variations in the myology of the negro. The published records on this subject, however, are entirely inadequate to definitely settle the question as to the relative preponderance of anomalies in the negro; and it is to be hoped that it will not be long before the vast collection of material that is to be found in the medical centres of the South will be utilized to solve this interesting problem. Among the more important variations that have been claimed as peculiar to the negro, we may mention the greater frequency of the psoas parvus, the greater persistence and development of the plantaris, the more frequent fusion of the flexor profundus digitorum with the proprius pollicis in the hands and feet, the greater persistence of the pyramidalis, the existence of a levator clavicule and other cervical muscles, the existence of the presternalis, the greater fusion and rudimentary character of the facial muscles, etc.; all of which have been pointed out as marked atavistic traits which make the negro a nearer kin to the quadrumana or lower species than the white man.

My experience as demonstrator of anatomy in New Orleans would lead me to accept the conclusions stated by Professor Testut in his masterly work on *Muscular Anomalies in Man* (*Les Anomalies musculaires*, Paris, 1884, p. 805), to the effect that, notwithstanding the assertions of numerous observers, we are not in a position to prove, at present at least, that we are acquainted with *any* anatomical disposition in the muscular system of the negro that is at all peculiar to the race, and that the evidence thus far submitted is not sufficient to demonstrate that muscular anomalies are more frequent in the negro than in the white subject.

Whatever may be the results of future investigations in this direction by philosophic anatomists, we must admit that the study of the myology of the negro is, to the surgical anatomist, barren of results.

The Viscera.—In a general way the differences that exist in the visceral anatomy of the negro as compared with that of the white can be stated only proportionally, as there are apparently no fundamental architectural differences in the plan of organization of the splanchnic organs. It is believed by all students of the negro in Africa and America that the thoracic organs, and especially the lungs, are less developed than in the white, while the reverse holds good with regard to the abdominal and pelvic organs. All the older Southern writers agree with more modern African observers on this point (Cartwright, Nott, Pruner Bey, Rochas, Cunningham).

As to the anatomy of the appendix vermiformis—an organ of exceeding interest to the surgeon as well as to the comparative anatomist—I can state that in examinations collected during ten years in the anatomical department of Tulane University, covering the examination of the cæcum and appendix of more than three hundred negro cadavers, I was never able to find any condition that was not reproduced in the same organs of white subjects. Neither was it possible to determine the existence of a pre-

ponderating type that would give the appendix of the negro an ethnic character. As a result of my examinations, it only appeared to me that the evidences of appendicitis or pericæcal inflammation were less frequent in the negro, though in both races the relative frequency of this condition appeared to be much less than one would be led to suspect by its reported prevalence in hospitals, and especially Northern clinics.

The Skin.—The highly differentiated skin of the negro is necessarily a fruitful source of study to the dermatologist, and gives to this race a decided individuality in actual practice. As general surgeons we cannot consider the numerous influences that the special anatomy and physiology of the skin exercise on its pathology. We must note, however, that, notwithstanding the enormous deposit of pigment that is contained in the skin of the negro, it appears to be one of the elements in its composition that is the least likely to cause disturbance. It is a remarkable fact that notwithstanding the extreme frequency of neoplastic formations in the skin, such as keloid, sarcoma, and other malignant growths, the pigmented or melanotic tumors are extremely rare in this race. The microbial flora of the negro skin has not yet been studied. This curious and interesting field of comparative bacteriology is still waiting a pioneer explorer. It would be interesting to observe the conditions of existence of the micrococcus epidermidis albus of Welch, which is the normal and obligate parasite of the skin in the white races. Do the altered and different conditions of environment affect the chromogenic reactions of this coccus? The glabrous or hairless quality of the negro skin is favorable to sterilization. Notwithstanding its usual hygienic neglect, the skin of the negro can be readily sterilized for surgical purposes by adopting the antiseptic methods that are now classical in surgical practice. No better proof of this is required than by observing how promptly the skin of the negro obeys the laws of tissue-repair under the protective influence of asepsis.

Physiological Characteristics.—It would be impossible, as well as unnecessary, in a contribution of this character to review in detail the general physiological peculiarities which distinguish the negro from the white man. The same general complaint must be entered here as in dealing with other phases of the comparative study of the race—viz. the abundance of personal impressions and lack of actually recorded facts.

Confining ourselves to the salient peculiarities of surgical interest, we shall insist, with all observers, on the lessened sensibility of the nervous system to pain and shock. It is also believed—and my personal experience confirms this impression—that the tactile sensibility as revealed by the esthésiometer is lessened. This would appear to be associated with a histological difference in the development and shape of the tactile papillæ of the skin (Bordier). This diminished peripheral sensibility is in harmony with the inferior organization of the race. Diminished sensibility is not peculiar to the negro, but common to all savage races. It is only brought out in relief when the negro is contrasted with the white man, and especially the more refined and intellectual types of the latter. This diminished sensibility is most striking in the savage negro. Livingstone was one of the first to call attention to the fact that the negro in his native African wilds can undergo the most painful operations with apparent indifference. The not uncommon practice of the Yoloffs,

who rip the abdomen open and handle the protruded bowels with the view of testing the virtues of the *gri-gris* given them by an itinerant marabout, and then returning the exposed entrails into the abdominal cavity without apparent concern (Bordier), is surely convincing, not only of the lesser sensibility of these people to pain, but also indicates a greater immunity from the usual dangers of peritoneal infection. Our daily surgical experience in the South proves that as regards pain the negro of to-day is true to the traditions of his savage ancestors. On account of this blunt sensibility of the nervous system the negro bears surgical operations remarkably well. "As is well known, the emotional side of the negro is well developed, and there is in him a certain tendency to fatalism which leads him to accept accidents and illness with all their consequences as parts of the inevitable, and to be borne without murmuring as the dispensations of a higher Power against which it is useless to struggle" (Balloch). More often I believe it to be due to a native and characteristic insouciance or indifference, which more certainly relieves the negro from worry as to the future than is likely to be the case with the white man.

This combination of circumstances—*i. e.* a naturally diminished peripheral sensibility, coupled with a more passive condition of the mind—makes the negro a most favorable subject for all kinds of surgical treatment with or without preliminary anæsthesia. As a rule, the negro bears anæsthetics well, and takes them readily enough if he has confidence in his medical adviser. If he is not properly prepared physically by previous assurances which increase his confidence and sense of security, his child-like superstitions and emotional nature are intensified and brought prominently into relief during the stage of excitement. Of course, the negro, like the white man, is subject to the dangers that are inherent to all kinds of general anæsthetics. Chloroform, which is the preferred anæsthetic in the South, acts on the negro precisely as it does on the white. Though chloroform, as a rule, is well borne by the negro when not suffering from conditions which contraindicate its use, I have known of more than one death in individuals of this race, demonstrating that they are just as susceptible to its dangers.

Cocaine anæsthesia is well adapted to the negro constitution. I cannot say that cocaine acts more decidedly in the negro as a local anæsthetic than in the white man, but it is probably because of his normally diminished sensibility that it is easier to obtain the maximum local effect of this agent with a minimum quantity of the drug. I have performed laparotomy for gunshot wounds of the abdomen; gastrostomy for inoperable œsophageal strictures; many typical amputations of the upper extremities as far as the wrist, and of the metatarso-phalangeal joint in the foot; amputations of the penis, castration, and other operations on the genitals; external urethrotomy; suprapubic cystotomy; ligation of large arteries (the deep primitive carotid near its origin, the external carotid and its branches to starve inoperable malignant growths, etc.), under cocaine anæsthesia, and I have come to the conclusion that Koller's great discovery, as modified by subsequent investigators (Corning, Reclus, Schleich), has proved as great a boon to the negro as it has to the white man.

It has been stated, especially by French naval surgeons who have

practised in the colonies in Africa and America, that the blood of the negro is thicker and darker, and that it coagulates more rapidly, than that of the white. To use an old expression, it exhibits a greater plasticity. It is stated that the corpuscles show a greater "adhesiveness" (Bordier). It has been claimed, on this account, that the negro is less likely to suffer from hemorrhage. At one time it was also believed that because of this greater "plasticity" of the blood the negro was more tolerant of mercurials, which, according to the old humoral doctrines, was an aplastic remedy and had a tendency to diminish this greater coagulability of the blood in the negro. I do not believe that any modern observer would be prepared to substantiate these views, and my impression is that as far as the coagulability of the blood is concerned the negro is not different from the white man. On the other hand, two of the worst cases of hæmophilia that have come under my observation were in pure negroes.

It may be well to mention in this connection, as a matter of therapeutic interest, that the blood of the negro bears admirably well dilution with the ordinary saline solution (.06 of 1 per cent.) that is used in surgical practice for the relief of acute traumatic anæmia and shock. Some of the most brilliant results which have been obtained by this method in desperate cases in our Charity Hospital practice have been in negroes.

The older authors laid a great deal of stress upon the different temperament of the races. Cartwright, who may be quoted as a representative of this class, laid great stress upon this feature in the negro constitution. He said that the liver and the rest of the glandular system are out of proportion to the sanguineous and respiratory systems, "the white fluids predominating over the red." In other words, the lymphatic temperament was dominant in the negroes. Whatever may have been the temperament of the race in this country when it was first imported from Africa, it is certain that at the present day the temperament is distinctly lymphatic, if by this we mean a predisposition on the part of the tissues to tubercular infection. That this is one of the characteristics of the colored race as we know it to-day is undeniable, as we will prove when dealing with its pathological characteristics.

Pathological Peculiarities.—We have already referred to the general immunity formerly enjoyed by the negro from certain diseases, and to the fact that this is rapidly disappearing, and that he now not only shares the physical weaknesses of the white race as exhibited in this continent, but is rapidly developing previously unknown predispositions which are increasing his general tribute to disease and death, even to a more fatal degree than in the white race. This tendency has become particularly manifest since the race has been thrown entirely upon its own resources, and since emancipation has compelled the negro to enter into active competition with the superior race that constitutes the dominant population of this country. From this we gather that absolutely specific diseases strictly limited to the negro race have ceased to exist in the American negro of to-day and that absolute immunity from certain diseases does not exist. The negro differs from the white man, pathologically, simply in the relative predisposition to, or immunity from, the various diseases that prevail in this country. "The fundamental nature"

(Quatrefages) is the same in both races, and the study of the morbid differences between the white and the black man must be based upon the action of the common factors of disease upon the acquired constitution of the negro; which, in America, must be regarded as the sum of his original race-distinctions plus the modifications due to a new environment and a fierce struggle for survival in competition with a superior race.

In analyzing the behavior of the tissues of the two races under comparison, the reactions of the tissues after traumatism deserves the first consideration, and those which are of the greatest interest to the surgeon are, first, the liability to infection, indicating thereby the greater or lesser resistance of the tissues, as well as the general defensive qualities of the organism as a whole; second, the history of regeneration and repair after injury and the relative frequency of tumor-formation. This last is important as indicating most clearly the histogenetic tendencies, as well as the trophic equation, of the tissues in each race.

THE TRAUMATIC INFECTIONS.—Of these, in order of frequency, we would place first the pyogenic infections which give rise to circumscribed suppurations, and which are bacteriologically related to a preponderance of the various staphylococci (aureus, citreus, albus, etc.); second, the graver and more progressive infections which are associated with the chain cocci (streptococci); third, the true septicæmias, the gravest of all infections, in which the cocci of various types of virulence, having broken through the barriers offered by the living tissues, have succeeded in effecting an entrance into the general circulation. Then will follow tuberculosis, tetanus, etc.

It will be impossible in the narrow compass of this contribution to attempt an exhaustive study of the relative prevalence and mortality of these infections. This subject has been exhaustively investigated by the writer in a statistical analysis of the records of the Charity Hospital of New Orleans for the ten years 1884–94. These records embrace a hospital population of 64,421 patients, of whom 70.15 per cent. were white and 29.85 were negroes.

From this extensive inquiry, which served as a statistical basis for this contribution, the writer has been able to draw the following conclusions:

(1) *Simple Pyogenic Infections.*—Under this heading are somewhat artificially grouped all acute circumscribed suppurations, such as furuncle, furunculosis, carbuncle, abscess (non-tubercular), phlegmon (852 cases—581 white, 271 negroes). The statistical summary shows that in proportion to the hospital population this class of infections was very nearly equally divided between the two races (13 in 1000 white; 14 in 1000 colored). The mortality, on the other hand (1.29 per cent. white), was three times greater in the negroes. If we exclude tubercular and syphilitic subjects, the tendency to simple pyogenic infection is about the same in both races.

Prof. Tiffany's statistics[1] as to variations according to topographical distribution are accepted as correct by the writer, without statistical confirmation. Thus, alveolar abscess is observed rarely in the dark negro, but frequently in the mulatto. This is due to the great rarity of dental caries in the pure negro and its great frequency in the mulatto.

[1] *Trans. Am. Surgl. Assoc.*, 1887.

Purely traumatic abscess or simple pus-infection, as seen in the hands and fingers, is much more common in whites (75 per cent.) than in negroes (25 per cent.).

Abscesses of the neck and axilla are much more frequent in the negro (56 per cent.) than in the white (44 per cent.). This is due chiefly to the greater prevalence of lymphatic tuberculosis in the colored race. The writer's statistics on this point exclude the tubercular element as much as possible, and the result shows, as previously stated, that simple pus-infections are about equal in both races.

Progressive Infections of the Streptococcal Type.—Erysipelas.—In ten years, 394 cases—314 whites, 80 colored. Deaths—white, 32; colored, 20. Proportional prevalence—70 in 10,000 white; 42 in 10,000 colored. Mortality—7 in 10,000 white; 10 in 10,000 colored.

Conclusions: Erysipelas is more prevalent among the whites, though, as usual, the mortality is greater in the negroes.

Septicæmia—Type, Puerperal Sepsis.—In the decennium, 1997 deliveries—1174 white, 823 colored women. Of these, 38, or 3.24 per cent., white, and 43, or 5.22 per cent., negro women had septic complications; or, more graphically, 32 in 1000 white and 52 in 1000 colored women were attacked by sepsis. The mortality from the same cause is estimated at 14 in 1000 white and 32 in 1000 colored.

Conclusion: Puerperal septic infection is much more frequent in the negro, and is also more than doubly fatal in women of the same race.

The cause of this excessive prevalence of, and greater fatality from, sepsis must be sought in conditions entirely outside of the hospital atmosphere. It is possible that there is a greater racial susceptibility to this kind of infection, but the results of our inquiry into the prevalence of the simple pyogenic and streptococcal infections would lead us to doubt any inherent organic predisposition. The vitiated physical and moral atmosphere and pre-existing infections, especially those of a venereal type, which prepare the way for the more formidable complications of the puerperium, would account for the greater prevalence and fatality of puerperal sepsis in the negro female.

Tuberculosis.—The great liability of the negro race to tuberculosis is illustrated by the hospital records, which demonstrate that in the last ten years pulmonary tuberculosis has been nearly *twice* as prevalent, and over *three* times as fatal, in the negro. The non-pulmonary and more typically surgical tuberculosis (tubercular abscess, T. adenitis; T. ulcers, T. spondylitis) was twice as prevalent, and more than twice as fatal, in the colored element. In the surgical lesions of bones and joints the negroes display, again, a greater liability (14 to 1000 white, 16 to 1000 colored), and much greater mortality in the negro (3 in 10,000 white and 12 in 10,000 colored).

Conclusions drawn from the preceding and other data gathered from the U. S. census of 1890 and other sources, all of which clearly harmonize on this subject, are stated as follows: 1st, that the contemporary negro population of the United States is more liable, and fatally liable, to tuberculosis in all its forms than the white population; 2d, that the precise reason for this great susceptibility has not been positively ascertained, but that it is probably due to several factors: (*a*) greater inherent racial susceptibility or weakness; (*b*) acquired predisposition, caused by (*c*) all the fostering

elements of a bad physical and social environment; and (*d*) miscegenation with the white race under the worst physical and moral conditions; 3d, that the inherent ethnic predisposition is not to be considered as of as much importance as the acquired predisposition, since the history of the negro in the United States proves that this excessive liability to tuberculosis is only a comparatively late manifestation, which began, practically, with the post-bellum period, as prior to this time (1865) the slaves enjoyed a comparative immunity from tuberculosis.

Tetanus.—As with tuberculosis, comparative pathologists all over the world unanimously agree that this disease is more common and more fatal among the negroes. The Charity Hospital records also emphatically confirm this belief: 107 cases of tetanus were treated in the hospital in the decennium—52 in whites and 44 in negroes. In proportion to the population, tetanus occurs three times more often in negroes. As to the mortality, we find that in both races it is frightful, but still the colored lose fully two and a half times as many as the whites from this disease. The trials recently made with Tizzoni's antitoxin, though too limited to permit the expression of a final opinion, have been sufficiently encouraging to justify the hope that the mortality statistics of the hospital will be very much improved in both races by the application of this agent in the returns of the next decennium.

Surgical Diseases attributable to Intestinal and especially Colonic Infection.

Suppurative Hepatitis and Hepatic Abscess.—A comparison of the statistics of the Charity Hospital of New Orleans with those of similar institutions in the Antilles and in Africa, where the influence of equatorial conditions upon racial pathology can be studied with greatest advantage, demonstrates that the universally admitted immunity which the negro in Africa enjoys from suppurative hepatic disease does not exist in the American negro. Malaria, diarrhœa, and dysentery are probably the most potent predisposing causes of hepatic abscess. These diseases were comparatively rare in the negroes in the earlier days of the slave-traffic, when the slaves still retained their original African characteristics, but at this moment the conditions have entirely changed. The negro is almost as liable to these affections as the white, and, in consequence, hepatic abscess, which is rare in the African negro, is now a common disease in his American brother. During the decennium (1884–94) 120 cases of abscess of the liver were treated in the Charity Hospital: of these, 130 were white and 52 negro patients. Proportionally to the total hospital population, this means that 29 of 10,000 white and 27 of 10,000 colored patients were admitted for this condition. The mortality is again very unfavorable to the negro—whites, 43.08 per cent.; negroes, 59.62 per cent. died.

Appendicitis.—In view of the presumably greater development of lymphatic tissue in the negro, we would expect to see this organ more frequently attacked by disease than in the white race. It is very doubtful, however, whether the appendix of the negro is more burdened with lymphatic tissue than that of the white race. It is certain, on the other hand, that intestinal lesions are certainly not more common in the negro than

in the white. At any rate, comparative statistics are not available to decide the interesting question as to the greater or lesser liability of the negro race to appendicitis. Upon questioning hospital experience for information on this point, we find that by putting together all the cases recorded as typhlitis, perityphlitis, iliac abscess, cæcitis, pericæcal abscess (names until quite recently applied to appendicitis), only 34 cases could be collected. Of these, 25 were in white and 9 in negro subjects. Proportionally to the population, this would mean that .055 per cent. of the white and .047 per cent. of the colored, or, 55 in 100,000 white and 47 in 100,000 colored, applied for the relief of this condition. On the other hand, 7 out of 25 white and 2 out of 9 colored cases died. It is evident that these figures are entirely inadequate for the purpose, though they suggest that the negro suffers less often and less severely from appendicitis; which is also in accordance with the personal experience of the writer.

As a whole, appendicitis appears to be less frequent in this section of the South than in the North—at least, according to hospital experience.

Peritonitis.—While this condition is almost invariably symptomatic, we find that 90 cases are recorded under this diagnosis alone. Of these, 45 were whites and 33 died, and 45 were negroes and 36 died. Proportionally to the population, this would mean that 100 in 100,000 white patients and 236 in 100,000 colored patients are admitted into the Charity Hospital for peritonitis. Proportionally, again, 73 in 100,000 whites and 187 in 100,000 negroes succumbed to this mode of infection. The only conclusion that these figures would suggest is that the susceptibility of the peritoneum to infection is certainly as great, if not greater, in the negro than in the white.

Pleural Infections.

According to the hospital statistics, the diseases of the respiratory organs, as a whole, are nearly twice as frequent and three times more fatal in the negro than in the white population. This preponderance is doubtless due to the greater excess of tubercular lung diseases.

The general belief that infectious pneumonia is more prevalent in the negro is amply sustained by the Charity Hospital statistics (nearly two and a half times more frequent in the negro). This increased liability to pneumococcal infection would suggest a greater prevalence of pleurisy and empyema in the colored race.

This suspicion is also clearly confirmed by the analysis of the hospital records, which, notwithstanding the careful exclusion of the tubercular cases (as far as the reports will permit), demonstrate that simple pleurisy (including all varieties) is, as a whole, more frequent, and nearly twice as fatal, in the colored population.

Empyema is nearly twice as frequent, and more than three times as fatal, in colored patients.

Endocranial Infections.

The diseases of the cranial contents that are of special interest to the surgeon are chiefly due to the pyogenic cocci and the tubercle bacillus.

They are manifested principally in connection with acute and chronic middle-ear and mastoid inflammations, and are recognized as secondary lateral sinus phlebitis, cerebral abscess, and meningitis.

All observers agree that this class of troubles is *much less* prevalent in the negro than in the white. The observations published by Murrell,[1] De Roaldes,[2] and Scheppegrell,[3] all concur in the general opinion that suppurative disease of the middle-ear is much less common in the negro, and that consequently mastoiditis, septic thrombosis of the lateral sinus, and cerebral abscess are less frequent in individuals of this race.

The statistics of the Ear, Eye, Nose, and Throat Hospital of New Orleans, based upon the records of 11,855 cases compiled by Scheppegrell (1895), present the following data:

Chronic suppurative otitis media	100	whites;	16	colored.
Acute catarrhal " "	100	"	56	"
Chronic non-suppurative "	100	"	26	"
Mastoiditis	100	"	6	"

These figures certainly show that the colored patients are much less disposed to contract this class of troubles than the whites.

These statistics refer, it must be remembered, to a mixed colored population, including the various shades of mulatto with the pure black.

"We must look to the anatomical differences of the nose and nasopharynx, the freedom from obstructive deformities in the septum, which are so common and injurious in the white, as the conditions that in a measure protect the negro from the suppurative and chronic catarrhal diseases of the middle ear" (De Roaldes).

While the negro is less liable than the white to cerebral abscesses and septic sinus-phlebitis because of his comparative immunity from middle-ear disease, we find that his liability to meningeal inflammations from general infections is just as great as in the white. In an analysis of 134 cases of meningitis we find that the colored population is both more liable and more fatally liable to contract this disease.

Hydrocephalus.—We have found that only 8 cases of this kind have been reported during the last decennium. Of 7 white cases, 4 died, or 57.14 per cent., and the only negro succumbed. If we may estimate upon so slender a basis, we would say that hydrocephalus is three times more frequent among the whites than in the negroes. I am afraid, however, that this is not the real state of the case, because observation shows that hydrocephalus is not so rare in the negro population out of the hospital as one would be led to suppose by the reports.

Neoplastic Formations.

That this is the most fruitful field of investigation for the racial pathologist is proved by the constant reference made by all observers to the much greater tendency displayed by the colored race to the development of new tissue-growths, especially to certain types of benign growths, such as keloids and fibroids. In order to ascertain the histogenetic tend-

[1] *Loc. cit.* [2] *Loc. cit.* [3] *Loc. cit.*

encies of the white and negro races as displayed in the local disturbances of the trophic equilibrium of the tissues that we recognize as neoplasms, the writer has carefully scanned the copious reports of the

FIG. 412.

Rare lipoma of forehead (service of Dr. Matas, Charity Hospital).

Charity Hospital of New Orleans, and has arrived at the following conclusions: 1st, that the tendency to the formation of neoplastic tissue, whether purely hyperplastic or heteroplastic, is greater in the negro than in the white race; 2d, that the typical mesoblastic derivatives of the adult connective-tissue group are specially prone to develop in the negro; 3d, that of this group the fibroma and cicatricial keloid preponderate sufficiently to give to the black race its most striking histological peculiarity.

With the view of establishing the comparative rate of prevalence of this class of neoplasms in both races, the writer gathered together all the cases of fibroids, fibro-myoma, fibro-lipoma, fibro-cystoma, fibro-enchondroma, and osteo-fibroma that were recorded in the hospital reports during the decennium (1884–94). A table comprising 178 cases of these tumors was thus obtained. Of these, 58 were white and 120 colored subjects—white, 32.58 per cent.; colored, 67.42 per cent.; or 13 in 10,000 of the white population and 62 in 10,000 of the colored population of the hospital were admitted for the treatment of these tumors. This clearly shows that fibroids alone, or when associated with histological elements of the same embryological derivation (mesoblast), occurred five times more often in the colored than in the white hospital population. Curiously enough, the mortality is exactly proportional to the prevalence—*i. e.* fibroids are five times as fatal in the negro race. This excessive

mortality is due no doubt to the great preponderance of aggravated and neglected uterine fibroids in negro women, who only appeal to hospital assistance when their sufferings are unbearable and after

FIG. 413.

Enormous fibro-lipoma, weighing about thirty pounds (service of Dr. Chassaignac, Charity Hospital).

the tumors have reached an advanced, complicated, and incurable stage of development.

The statement made by Peaslee in 1872 that very few women die, above the age of forty, at the home for colored incurables in New York,

FIG. 414.

Pendulous lipoma (service of Dr. Matas, Charity Hospital).

who are free from these diseases, is well sustained by the writer's experience as demonstrator of anatomy for ten years in the anatomical laboratory of Tulane University, and will be doubtless corroborated by all

Southern gynecologists. Balloch,[1] in an excellent summary on the evidence, after quoting the confirmatory opinions of such authorities as

FIG. 415.

Enormous firbo-lipoma of thigh, with patches of ulcerated skin, from traumatism in negro adult (service of Dr. E. Souchon, Charity Hospital).

Rufz de Levison of Martinique, Jackson of Barbadoes, Flint Thomas of New York (E. Briggs of Nashville, Tiffany of Baltimore, Richardson, Chaillé, and Lewis of New Orleans could also be mentioned), adds a few striking figures from the reports of autopsies made by Dr. D. S. Lamb and J. W. Blackburn of Washington, which entirely harmonize with Peaslee's statement and the statistical conclusions drawn from our hospital experience in New Orleans.

What has been said of the greater prevalence of fibroids in the colored race is even more true of keloid, elephantiasis, and fibroma molluscum, which must be recognized as the most typical, though not exclusive, diseases of the negro in this country. Though each one of these is a separate and well-characterized morbid entity, they are all linked together by a common process which underlies their pathology—*i. e.* a hyperplasia of the adult connective tissue. They all emphasize the dominant pathological peculiarity of the negro—viz. a tendency to excessive fibroid growth at the least provocation.

Our hospital experience in New Orleans in keloid, though comparatively limited, because relief from these tumors is rarely sought unless they are very unsightly or are complicated with other more painful or dangerous conditions, would indicate nevertheless that keloid is at least nine times more prevalent in the negro than in the white. With very few exceptions the cases seen in our hospital wards are true keloids of traumatic origin: there are comparatively few cases of so-called spon-

[1] "The Relative Frequency of Fibroid Processes in the Dark-skinned Races," *Medical News*, Philada., 1895.

taneous chéloide of Alibert in which no history of antecedent traumatism

FIG. 416.

Enormous fibro-chondroma of parotid region (patient of Dr. Plunkett, Flora, Miss.).

can be elicited. It is remarkable what little injury is required to pro-

FIG. 417.

Elephantiasis of foot (non-parasitic) from cicatricial obstruction in adult negro (Charity Hospital Clinic).

duce a keloid in a predisposed subject. The merest desquamation from

pustular or eczematous eruption may be a source of sufficient irritation to induce the hyperplastic cicatricial (keloidal) process. One of the worst cases of disseminated keloid that has come under the writer's observa-

FIG. 418.

Molluscum fibrosum pendulosa of umbilical region, weighing thirteen pounds. The whole surface of the body was covered with smaller mollusca; light mulatto woman (removed by Dr. Matas).

tion occurred in a negro who had suffered from varioloid. Another very extensive case, in which a flat confluent keloid mass covered the sternum and mammary regions, also in a negro, was caused by a superficial eczema due to the irritation from a porous plaster. Some of the most extensive and deplorable cases are connected with cicatrization after extensive burns.

As to the clinical peculiarities of keloid and its treatment, the experience of the writer is thoroughly in accord with that of all Southern surgeons of experience. Professor Tiffany in his paper before the American Surgical Association[1] covers the essential points that are worthy of remembrance: "The tendency of keloidal growths is most pronounced in early life, less so in the adult, while it is highly probable that middle and old age are accompanied by a tendency on the part of the formations in question to cease growing and atrophy. Hence an aged negro with keloid is exceptionally seen. Retrograde change is characterized by the surface becoming soft and wrinkled, resembling somewhat the pendulous tumor of fibroma molluscum. Removal of keloids in early life is to be deprecated, speedy recurrence being inevitable: when the period of rapid growth has passed an operation can be undertaken with the prospect of relieving the patient from a present discomfort and the expectation of a limited recurrence, if at all."

Malignant Neoplasms.—Sarcoma and Carcinoma.—The negro constitution has probably undergone some change under the conditions of American civilization, since it cannot be doubted that cancer is comparatively rare in the native African (Girard, Huard, Chassaniol, Bordier); rare also in the original slave population of this country; and has

[1] *Loc. cit.*

only become a common disease among them in the last few generations. It is probable that the conditions that are causing an increase in the prevalence of cancer among the whites are operating with the same, or greater, effect upon the negroes. According to Carson[1] and other observers, cancer is more common now than before emancipation, when the "vital equation" of the races was better. Notwithstanding the data furnished by the census of 1890, and the opinions of able observers who have expressed the belief that cancer is not so common in the negro as in the white, the evidence furnished by the Charity Hospital of New Orleans would indicate that the reverse of this proposition is true. Taking all the varieties of sarcoma as an example, we find that of 169 cases recorded in ten years, 95 were white and 74 negro subjects. Proportionally to the hospital population of the decennium, the rates of prevalence would be .210 per cent. for the white and .285 per cent. for the colored element, or, stated more graphically, 21 in 10,000 white patients and 28 in 10,000 colored, had some form of sarcoma.

FIG. 419.

Multiple cicatricial keloid after pustular eruption (service of Dr. Matas, Charity Hospital).

The melanotic sarcomas constitute an apparent exception to the rule. They are certainly very rare in the negro outside of the eye. The only cases that have been recorded in the hospital in ten years are three in number, and these were all white patients. On the other hand, malignant lymphoma or lympho-sarcoma of the neck, especially, exists quite frequently, and the most rapidly fatal examples of this disease have been seen in the negro wards of the hospital.

In another group we have entered all the recorded cases of cancer, including all the diagnoses of carcinoma, scirrhus, encephaloid, epithelioma—in all 815 cases; 510 of these in white and 305 in colored patients. The rate of prevalence was 1.13 per cent. for the white and 1.59 per cent. for the negro hospital population (11 in 1000 white and 16 in 1000 colored), showing, apparently, that the epithelial growths are just as frequent in the negro as in the white race.

We would conclude, for our personal and statistical experience in reference to malignant diseases, (1) that the mesoblastic derivatives of the embryonal connective-tissue type—*i. e.* sarcomata—are apparently more

[1] Dr. Eug. R. Carson, "The Vital Equation of the Colored Race and its Future in the United States," Wilder, *Quarter-Century Book*, Ithaca, N. Y., 1893.

frequent in the negro (as Balloch had previously announced), with the sole exception of the melanotic sarcomas, which are rare; (2) that, contrary to

FIG. 420.

Lupus verrucosus of face, adult negro (Charity Hospital Clinic).

FIG. 421.

Sarcoma of orbit and face, young negro (Charity Hospital Clinic).

the generally accepted belief, the epiblastic derivatives of embryonal type, or the true cancers, appear to be also as frequent in the negro race.

The Venereal Infections and their Complications.

This includes the venereal trilogy: syphilis, chancroid, and gonorrhœa.

According to statistics of the Charity Hospital of New Orleans, the venereal diseases, as a class, are more prevalent (white, 43 in 1000; colored, 55 in 1000) and three times more fatal in the negro (white deaths, 11 in 10,000; negro deaths, 33 in 10,000).

Syphilis.—Prevalence.—2.84 per cent. of the white patients admitted to the hospital during the decennium were admitted for syphilitic diseases (28 in 10,000); and 5.06 per cent. (or 51 in 1000), or nearly twice as many negroes, were admitted for the same causes.

Mortality.—The deaths caused by syphilis are exactly three times greater in the colored than in the white population of the hospital.

Conclusion: The statistics of the Charity Hospital evidently confirm the generally accepted opinion that syphilis is more widely disseminated among the colored population; but, contrary to the opinion of many, it is decidedly more fatal among them.

The writer believes that if the mulatto could be entirely eliminated from the statistics the results would prove that, all other conditions being equal, syphilis is less virulent and less fatal in the pure negro than in the white.

Chancroids.—899 chancroid patients were admitted in the Charity Hospital. They were all complicated and serious, otherwise they would not have sought admission into the institution. Of these, 587 were white and 312 colored. The rate of prevalence was—white, 13 in 10,000; colored, 16 in 10,000. The excess of negroes is accounted for by several causes, notably among which are the long phimotic prepuce of the negro, which, lacking in hygienic attention, predisposes to balanitis, and thus prepares the soil for infection. The weaker lymphatic system of the negro may also predispose to lymphangitis and bubo. Phagedenic and serpiginous ulcerations are certainly seen more often in the negro services than elsewhere, in consequence, no doubt, of the ignorance, carelessness, and general indifference to diseases which characterize the race.

Gonorrhœa.—The indoor services of even a large hospital are unfavorable for the comparative study of uncomplicated gonorrhœa. These cases usually apply to the outdoor clinics for relief or are treated by druggists and others. As with chancroid and syphilis, it is only the complicated cases of gonorrhœa, which entirely incapacitate the patient for his work, that apply for admission. There were 366 cases of gonorrhœa admitted in the indoor services; and of these 287 were white and 79 negro subjects; rate of prevalence, white, .635 per cent.; colored, .411 per cent., the preponderance being decidedly with the whites. If we investigate the relative number in the out-clinics, we find that the conditions are reversed, and that the disease is more frequent in the negroes. This conclusion is apparently sustained by Surg. S. T. Armstrong's report on "the frequency of disease in the white and colored races," according to which, gonorrhœa prevails in 8.8 per cent. of the white and 12.6 per cent. of the colored patients in the outdoor department of the U. S. Marine Hospital at Memphis.[1]

[1] "A Comparison of the Frequency of Disease in the White and Colored Races at the U. S. Marine Hospital, Memphis, Tenn., during the quinquennium 1881–86," *Annual Report Sup. Surg.-General, U. S. Marine Hospital Service for 1886*, pp. 123–130.

Seeking for other evidence of the relative status of the races in regard to gonococcal infection, we find some information in the comparative study of the sequelæ and complications of this disease in the male and female:

Stricture of the Male Urethra.—One of the most important and serious sequelæ of gonococcal infection is stricture, and, as this is essentially a fibroid (cicatricial) process, its relative frequency in the two races is a matter of interest.

The decennial reports of the Charity Hospital show that 546 patients were admitted for stricture—299 white and 247 colored; of these, 13 white and 31 colored died. The proportional prevalence would therefore be, for the white population, .622 per cent., or 62 in 10,000, and for the colored, 1.284 per cent., or 128 in 10,000. According to this experience, urethral stricture is twice as frequent and five times more fatal in the colored hospital population.

The experience of the writer in regard to stricture in the negro coincides in every particular with the statement made by Dr. Carson of Savannah, Ga.,[1] who says: "I have never among the whites seen such neglected cases of old strictures where urethral abscesses and fistulas have formed, and where they have been content to go along without interference until, perhaps, extravasation of urine has compelled them at the eleventh hour to seek surgical help."

Orchitis and epididymitis are apparently less frequent in the negroes. Out of 250 cases, 202 were white and 48 colored; proportionally to the white and colored hospital populations, the rates would be—white, 45 in 10,000; colored, 25 in 10,000.

Cystitis is apparently less frequent in the negro: of 229 cases, 164 were white, 65 colored. Proportional ratio to population: .363 per cent. whites; .338 per cent. colored.

Gonorrhœal rheumatism prevails with about the same frequency in both races (proportional ratio to population)—white, .0376 per cent.; .0312 per cent. colored.

Acute prostatitis is rare in both races—only 3 recorded cases in ten years: 2 of these were white and 1 colored.

Gonorrhœal Ophthalmia.—The mucous membrane of the eye, like that of the urethra, is more subject to gonococcal infection in the colored than in the white subject. Of 35 cases of this ophthalmia, 17 were white and 18 were colored subjects. Proportionally to hospital population: 38 in 100,000 white and 94 in 100,000 of colored population are victims of this complication.

In conclusion, according to the records of the Charity Hospital the gonorrhœal poison is only more active in the negro in the urethral and ocular mucosæ; it is also probably more prevalent in the genital tract of the negress, judging by the statistical excess of endometritis and salpingitis in the female negro gynecological wards. The poison is apparently less virulent than in the white race in the testicles, bladder, lymphatics, muscles, and joints (gonorrhœal rheumatism).

To conclude with the genito-urinary diseases of surgical interest, we find that *hydrocele* of the tunica vaginalis testis is more frequent in the negro; thus, 108 cases—whites, 68; colored, 40. Rates of prevalence

[1] *Loc. cit.*, p. 149.

to population—white, .151 ; colored, .208 per cent. ; or 15 to 10,000 white and 21 to 10,000 colored.

Senile hypertrophy of the prostate appears to be more frequent in the negro, as we would be led to suspect by the peculiar fibroid tendencies of the race. Thus, 37 cases—22 white, 15 colored ; ratio of prevalence—white, .049 per cent., .078 colored ; 49 in 100,000 white, and 78 in 100,000 colored.

As a whole, hypertrophy of the prostate is not a common hospital disease—in New Orleans, at least.

Urinary calculus is reported to be a rare disease in the negro. In reality, it is a comparatively rare disease in both races in the Southern States that border the Gulf Coast. In ten years only 43 cases have been recorded in the Charity Hospital—33 in whites and 10 in negro subjects—76.74 per cent. white, and 23.26 per cent. colored. Ratio of prevalence—.073 per cent. white, .052 per cent. colored (= white, 73 in 100,000 colored, 52 in 100,000).

According to hospital experience in New Orleans, it would appear that urinary calculus certainly exists in the negro, but is apparently less frequent in the race. Dr. G. B. Johnson in a valuable paper[1] has succeeded in collecting 1064 cases of stone in the bladder in the Southern States. Of these, 952 were in white subjects and 116 in negroes. The negro cases represent 9.53 per cent. of all the cases reported. This showing is quite sufficient to disprove the idea of immunity which the negro has been supposed to enjoy.

Bones and Joints.

Rickets is a comparatively rare disease in the Southern States. Some idea of the rarity of this condition is obtained by an examination of the records of the Charity Hospital of New Orleans, which show that in ten years only 14 cases were admitted to the indoor service for the treatment of this condition. Of these 14 cases, 9 were white and 5 colored patients. The population of the Southern States, including the negro element, is therefore no exception to the comparative immunity enjoyed by the North American continent against this condition.

Fractures.—In ten years 1894 cases of fractures were admitted in the Charity Hospital for treatment ; of these, 1333 (70.38 per cent.) were white and 561 (29.62 per cent.) were colored. The ratio of prevalence to hospital population was—white, 2.95 per cent. ; colored, 2.92 per cent. (= 295 in 10,000 white and 292 in 10,000 colored).

The *mortality* ratio was 319 per cent. white and 301 per cent. colored (white, 32 in 10,000 ; colored, 30 in 10,000). These figures would indicate that the prevalence of fractures is very evenly balanced between the two races, and that, if there is any difference between them, it is in favor of the colored patients. The conclusions that spring from this statistical result are that the negro is not rhachitic and has no greater tendency to fracture than the white man, and that his chances of recovery are also just as good.

Dislocations.—A study of 174 dislocations (134 white, 40 colored)

[1] "Trans. Southern Surgical and Gynecological Association," 1895, *Med. News*, p. 695, Dec. 21, 1895.

yields the same conclusions arrived at in connection with fractures—viz. that the races are nearly on a footing of equality on the subject both as to frequency and to mortality, the difference being in favor of the negro. The ratio of prevalence—.297 per cent. for white population; .208 per cent. colored population, or 30 in 10,000 white, 21 in 10,000 colored.

Surgical Diseases of the Circulatory System.

Aneurysm.—A table comprising all the aneurysms (almost exclusively "idiopathic") was compiled from the hospital records (ten years), and a total of 199 cases was obtained. Of these, 143 were in white subjects (71.86 per cent.) and 56 in colored patients (28.14 per cent.).

The rate of prevalence would be .316 per cent. for the white and .291 per cent. for the colored population (= 32 in 10,000 white and 29 in 10,000 colored hospital population). According to this synopsis, the "idiopathic" or non-traumatic aneurysms are less frequent in the colored population. This lesser liability of the negro to aneurysm in the hospital reports is probably due to the comparative immunity from rheumatism and gout that is enjoyed by the race, since these diseases powerfully predispose to arterial disease. On the other hand, the relative freedom from gout and rheumatism is offset by the greater dissemination of syphilis in the negroes and the gradually increasing spread of alcoholism among them. These two causes alone are increasing the predisposition to arterio-sclerosis and raising the negro's liability to aneurysm to the statistical level of the white race. It is the writer's belief that if aneurysm is not altogether as frequent in the negro at the present moment, it will not be very long before the races will be on an equal footing in this deplorable field of competition.

Hemorrhoids and Varicose Veins.—Notwithstanding the comparatively greater anatomical capacity of the venous system which the negro is believed to possess, varicosities of all kinds appear to be less frequent in this race. Of 235 cases of hemorrhoids, 195 were in white and 40 in colored subjects, or white, 82.98 per cent.; colored, 17.02 per cent. Ratio of prevalence to white population—.432 per cent. (43 in 10,000), and .208 per cent. (21 in 10,000) of colored patients.

As to varicose veins in general, we find that of 59 cases admitted, 81.36 per cent. were white and 18.64 colored. Ratio of prevalence—.106 per cent. for white (11 in 10,000) or .057 per cent. colored (6 in 10,000).

It is suggested by this evidence that as regards varicosities the negro of the present day still exhibits a pathological trait that is common to all savage or primitive races.

Hernia, especially the umbilical variety, is reported by all medical observers in Africa and the Antilles as being more frequent in the negro. Corre[1] goes so far as to suggest that this condition is so frequent in negro children because the circular muscular ring of unstriated fibres around the umbilicus (first described by Richet) is defectively developed in the African infant. It is more likely due to careless dressing of the cord and to the greater neglect of the infants, as suggested by other writers. At any rate, the general belief that hernia is more frequent in the negro appears to be confirmed by hospital statistics.

[1] Quoted by Bordier, *La Géographie médicale*, Paris, 1884.

Thus at the New Orleans Charity Hospital 170 cases were admitted; of these, 110 were white (64.71 per cent.) and 60 (35.20 per cent.) were colored. Ratio of prevalence to population—white, .243 per cent. (24 in 10,000); colored, .312 per cent. (31 in 10,000).

Congenital Deformities.—With the exception of phimosis, which is nearly twice as frequent in the negro, the congenital deformities have always been held to be more rare in the negro than in the white population. The experience of the Charity Hospital would apparently confirm this opinion. Hare-lip and cleft palate, for instance, are comparatively rare conditions in indoor hospital experience. In ten years only 15 cases were admitted for treatment, though doubtless as many more were treated in the outdoor clinics and are not recorded. Of the 15 cases on record, 11 were in whites and 4 in negroes. I am satisfied by years of experience and observation that this class of defects is more common among negroes than is currently believed. Outside of the hospital, the writer has seen several cases of hare-lip and extensive cleft palate in typical negro children. One of the reasons why these conditions appear to be less frequent is the greater mortality among the black infants thus afflicted, because it is difficult for these to receive the intelligent nursing and constant maternal attention that they require.

As to club-foot, we find that the colored race is distinctly favored, for out of 24 cases only 1 was a colored child. A brief examination of the records for genu valgum, genu varum, hallux valgus, syndactylism, exstrophy of the bladder, epispadias, hypospadias, spina bifida, atresia of the anus and rectum, and other familiar congenital deformities indicates that these conditions exist in the colored race, though the limited number of each will not permit the writer to formulate any comparative conclusions.

Diseases reputed to Prevail exclusively in the Negro Race.

These are—the African cachexia or sleeping sickness of West Africa, beriberi, yaws pian, or frambœsia (or negro syphilis); elephantiasis, traumatic keloid, phagedenic ulcer of the tropics or Mozambique ulcer; ainhum. Of these, the last six only are of surgical interest. None are the exclusive attributes of the negro race. Not one of these is, we repeat, especially distinctive of the race. A wider knowledge of geographical distribution of disease and a closer study of tropical maladies have clearly demonstrated that all races, including the Aryan, when subjected for a sufficient length of time to the active causes of these diseases in tropical or otherwise favorable latitudes, are exposed to them. It is universally recognized, however, that the negro is especially disposed to contract these diseases, while the white race enjoys a relative immunity.

With the exception of keloid and elephantiasis (which are discussed in other sections of this work) all the diseases of this group are true exotics. *Yaws* or *frambœsia* is one of these. It was first brought to this country and to America by the slaves from Africa. It prevailed extensively in the negro population as long as the slave-trade existed and fresh reinforcements came from the mother-country. With the cessation of the slave-traffic the prevalence of yaws rapidly declined, until the

disease became one of the rarest curiosities even in the most densely-settled negro districts. The recent researches of Nichols and Numa Rat in the English Antilles have conclusively demonstrated its specificity by the discovery of a definite micro-organism which is invariably associated with the clearly differentiated lesions of this disease. At one time it was thought that it was simply a manifestation of the syphilitic poison profoundly modified by the negro constitution; but the history of this disease in the United States, its rapid extinction since the cessation of slavery, plainly separate this peculiar infection from syphilis. How rare yaws has become in this country is demonstrated by the records of the Charity Hospital in New Orleans, which show that only two cases have appeared in its clinics in the last nineteen years. One was an imported case, a mulatto from Mauritius, treated in the service of Prof. Jones in 1877, and the other, a full-blooded negro, who came under the observation of Dr. M. S. Souchon in the summer of 1895. This patient was a Louisianian by birth: there is no clue in his history by which contagion may be traced. Still, we are loath to believe that this disease can originate *de novo* in the United States. The appearance of this patient, showing the numerous warty excrescences that cover the body, is so characteristic of "yaws" that we append his photograph as

FIG. 422.

Frambœsia or yaws (service of Dr. M. S. Souchon, Charity Hospital).

an illustration (Fig. 422). This disease is self-limited and the prognosis usually favorable. While hygienic and internal tonic and "alterative" medication is valuable, the greatest reliance must be placed upon local treatment. Continuous antiseptic baths—containing sulphide of potash, for instance, associated with excision and cauterization (chemical and

thermo-cautery) for the yaws warts themselves—will finally destroy the external lesions.

The so-called *Mozambique ulcer*, also known as *tropical phagedenic ulcer*, is met with in all tropical countries—Asia, Central America, the West Indies, and Africa. It is certainly not specific to the negro, but most frequently attacks the black and yellow races. It greatly harassed the members of Stanley's Emin Pasha relief expedition. Parke, the surgeon to the expedition, states that "as soon as the opportunity was furnished by rest and good food the ulcers of all those whose systems had not been wholly undermined by the hardships to which they had been exposed healed up rapidly and completely under simple treatment." It is not known in this country as an independent morbid entity.

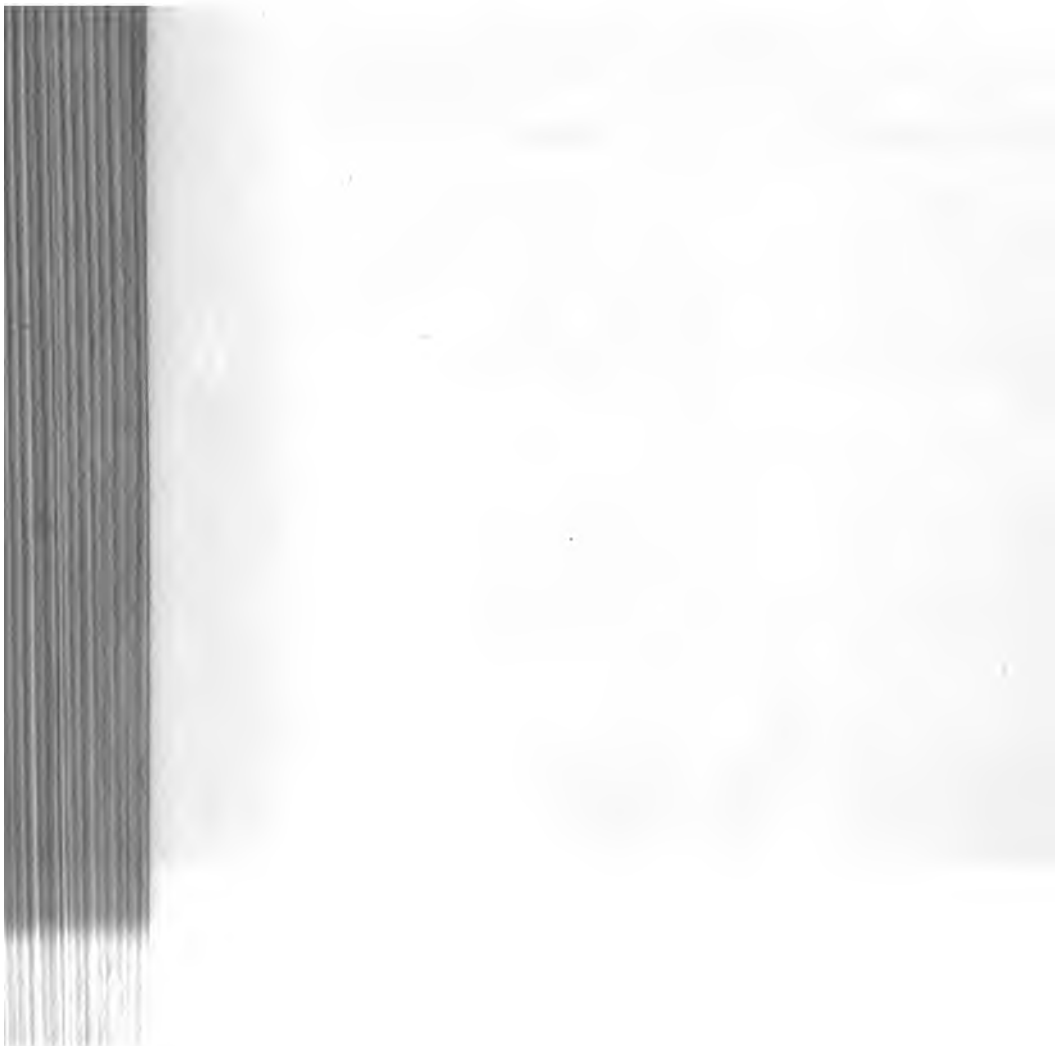
The tendency to phagedena that is so frequently observed in the neglected chancroids and buboes of the negroes in our Southern clinics is possibly a relic of the African disposition to malignant ulceration in depressed constitutional conditions.

FIG. 423.

Ainhum, annular scleroderma of little toe preceding spontaneous amputation (service of Dr. Matas, Charity Hospital).

Finally, a word as to *ainhum*. This is a disease which has been claimed more persistently than others to be truly specific of the negro race. Nevertheless, Mirault, Frontan, and others have observed it in white subjects. Ainhum was first recognized and described as a separate disease in 1867 by Da Silva Lima of Bahia, Brazil. The name *ainhum*, or *ainhoum*, is derived from the Brazilian negro patois meaning a fissure (Bordier). It is characterized essentially by the formation of a deep groove or sulcus at the digito-plantar junction of the little toe, though the other toes may also be affected. This sulcus continues to increase in depth until the toe hangs to the foot by a slender pedicle, which is finally severed and the toe drops off. The appearance of the toe resembles very closely that which would follow a gradually increasing linear constriction or strangulation with a thread. It is very slow in its progress, from one to ten years being required to effect a spontaneous amputation. It is evidently a tropho-neurosis which begins as an annular scleroderma.

The general health is not affected in the least. The disease is apparently altogether local. It may be mistaken for leprosy, but a little attention will soon differentiate this lesion from the manifestations of that disease. It has great affinities with that type of symmetrical gangrene or local asphyxia known as Reynaud's disease. Dr. Dell' Orto of New Orleans and the writer were the first to recognize ainhum in Louisiana. The writer has seen only one well-authenticated case in New Orleans, and the local appearances are well represented in the accompanying photograph (Fig. 423). It is certainly a rare disorder in this country, differing in this way from leprosy, which is relatively prevalent in Louisiana. Little can be said of the treatment. Moncorvo claims to have aborted the disease by cutting through the sclerodermic ring, but in the majority of the cases amputation, which is usually bloodless and painless, will be required.



DISEASES OF THE FEMALE BREAST.

By FREDERIC S. DENNIS, M. D.

Anatomy of the Breast.—The mammæ may be regarded as enlarged cutaneous sebaceous glands. Champneys and Bowlby have shown that human milk and sebum differ only in degree. The mammary glands have for their object the nourishment of the infant. For the purposes of anatomical description the entire gland may be subdivided into two parts—the secreting organ itself and the nipple.

The organ itself is a compound racemose gland, and is situated in the human species upon the antero-lateral aspect of the chest, in what is known as the mammary region. It is wisely planned that the breasts in the human female are so placed that the mother can give nourishment to her offspring while holding her young in her arms.

In the infant and up to the time of puberty there is very little difference in the external appearance of the breasts in the two sexes. As the female advances toward the period of puberty a change becomes marked, and the breasts assume the shape and form characteristic of the virgin. As the male advances toward puberty there is practically no apparent change, and the glands remain rudimentary, although in exceptional cases the breast may become swollen and slightly painful.

The anatomical structure of the gland itself is rather complex, since it is formed of small secreting glands, which are held together by a fibrous membrane which enters into the substance of the gland itself and sends off trabeculæ into all the interstices (Fig. 424). The gland

FIG. 424.

Anatomical formation of female breast (Cooper).

is thus formed of from fifteen to twenty concrete lobes which are subdivided into lobules. Each lobe is held together by fibrous tissue, around which is deposited fat. Each lobule and its acini are surrounded

by connective tissue which may give rise to sarcoma. The acini and the ducts may be the seat of adenoma and epithelioma. The entire gland is held within a capsule.

In this manner the conglomerate gland is formed. From these small glands lactiferous ducts come off to terminate at the nipple. In the connective tissue are imbedded the arteries and veins, absorbents and nerves, which proceed into the substance of the gland and nipple.

The general form of the breast is hemispherical upon the front and concave behind, where it conforms to the convex shape of the thorax.

FIG. 425.

Breast of woman who has been pregnant, showing pigmented areola and position of gland.

The breast is attached to the inferior portion of the platysma myoides and to the anterior surface of the pectoralis major muscle; also to a portion of the serratus magnus and external oblique muscle, and to a small extent to the cartilages of the ribs. The gland, imbedded in connective tissue, is placed within the two layers of the superficial fascia, which divides in order to receive it. The posterior concave surface of the gland is movable in its slight excursions up and down and laterally over the pectoral muscle. Sometimes a bursa exists between the muscle and gland. The anterior convex surface is connected to the integument by fibrous bands and separated from it by a layer of adipose tissue.

The circumference of the breast is not entirely symmetrical, since it has offshoots or prolongations of different lengths from the nipple. Thus a circular amputation of the mamma might leave behind part of the gland, which in case of disease would supply a nucleus for a further development of the growth.

The size and shape of the human breast are subject to wide variations depending upon sex, age, and race, the functional activity of the glands,

FIG. 426.

Breast of virgin, showing pink areola and position of gland.

and the climatic influences which surround the individual. There is a marked difference between the male and female in the development of the mammæ. In the male the glands usually undergo atrophy and present no functional activity. In the female the mammæ attain their form and characteristic shape at puberty, but from infancy to puberty the breasts develop slowly, and at the latter period attain their shape and size largely from the fibro-fatty envelope. There is a marked sympathy between the female sexual organs and the mammæ, so that any pro-

tracted disease of the former has an important influence upon the growth of the latter, a typical illustration of which is seen in certain cases of hypertrophy of the breasts. At puberty the breasts become hemispherical prominences which are situated upon the front of the upper part of the chest on either side of the median line, and cover an area which extends from the third to the seventh rib and from near the border of the sternum to the anterior axillary border. From the circumference of the base certain prolongations and processes shoot out from the body of the breast. The glands are attached to the superimposed skin by fibrous trabeculæ, which have been called the suspensory ligaments of Sir Astley Cooper, and by certain fascial attachments to the clavicles.

The general appearance of the breast differs according to the age, race, and condition of the female. At puberty the breasts stand firmly out from the chest-wall, but after lactation become flabby and pendent (Figs. 425, 426). In tropical regions the breasts are much larger than in colder climates, and among the Hottentots the mammæ are said to be very large and lax. In some cases they are so pendulous that they may extend as low as the groin. Cuvier states that among the Hottentots the breasts have been thrown over the shoulder, and the infant suckled while carried upon the back of the mother.

Fig. 427.

Nipple and areola (Cooper).

At the apex of the virgin breast the nipple is found (Fig. 427). In the female in whom the breast has performed the lacteal function the situation of the nipple is subject to wide variation. In the male and in

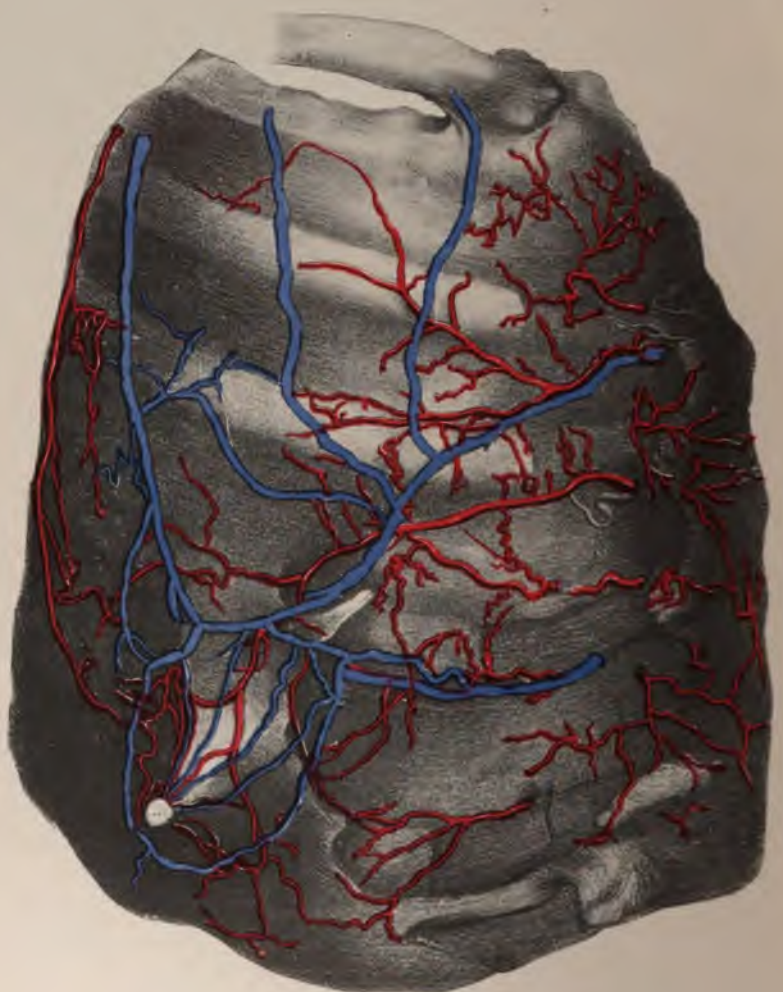
Fig. 428.

Anatomical arrangement of milk-ducts (Cooper).

the virgin the location is over the fifth rib and nearly an inch beyond the junction of the fifth rib with the cartilage. The body of the breast lies just below and to the outside of the axillary border of the pectoralis major muscle. Heidenhain has pointed out the anatomical fact that the gland has a very thin and incomplete capsule, and has intimate attachments to the pectoral muscle. This explains the infiltration of carcinoma into the muscle, and suggests the important clinical fact that in removing the gland for carcinoma the pectoral fascia and muscle should also be dissected away from the chest.

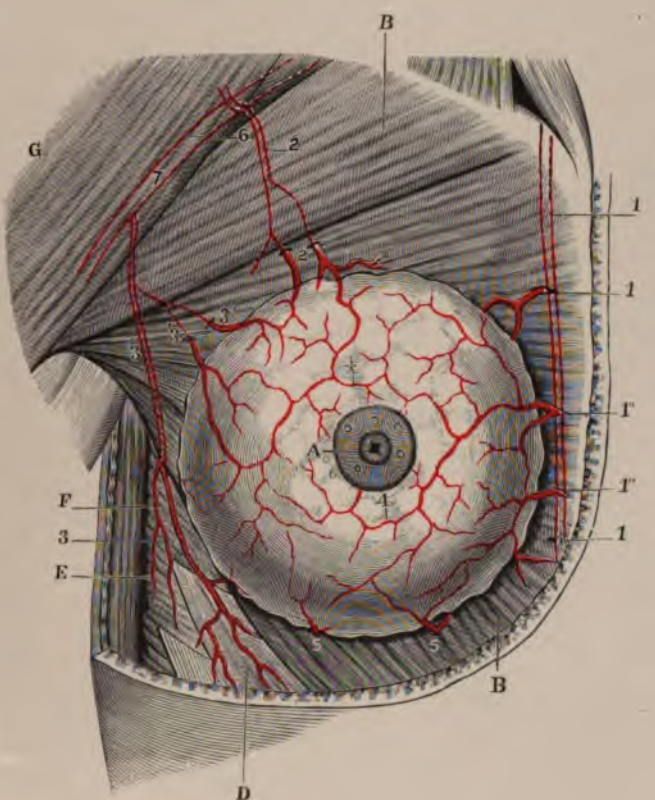
The gland has three principal prolongations, one of which is attached toward the sternum and the other two run respectively toward the upper and lower part of the axilla.

PLATE XII.

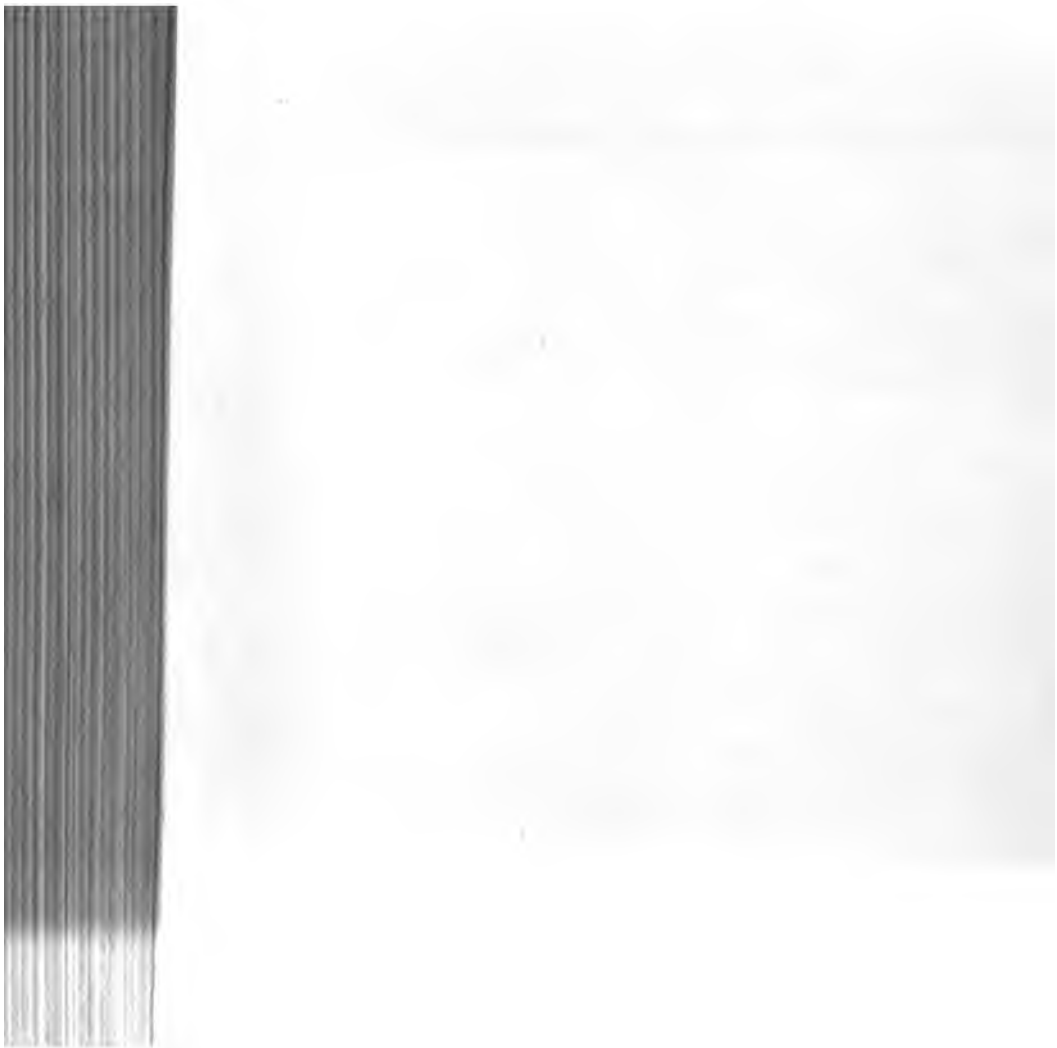


Showing Arterial and Venous Supply to Breast. (COOPER.)

PLATE XIII.



Showing Arterial Supply of Breast. (TESTUT.)



Stiles has demonstrated the presence of true glandular tissue in the fibrous septa which project from the front of the breast and are imbedded in the suspensory ligaments of Cooper as they extend into the corium. From this anatomical description it follows that no skin overlying the gland should be left unremoved in the operation for the relief of cancer of the breast, and that the incision should extend toward the median line, as well as high up into the axilla and down toward the lateral aspect of the chest. Without attention to these details carcinomatous nodules are sure to be left behind in amputation of the breast.

The *vascular supply* of the breast is derived from the axillary and internal mammary arteries. The outer and lower portions of the gland derive their blood from branches of the long thoracic which come off from the axillary artery just beneath the pectoralis minor muscle and run along the outer border of the muscle, sending off several smaller branches to the above-mentioned portions of the breast and likewise to the nipple (Plate XII.).

The inner and lower portions of the gland derive their blood-supply from branches of the external mammary, which comes off from the axillary at a lower point than the long thoracic artery. This artery also sends branches to the nipple (Plate XIII.).

The upper portion of the gland derives its blood-supply from the branches of the acromio-thoracic from the axillary, which are given off above the inner margin of the pectoralis minor muscle. These small branches perforate the substance of the pectoralis major muscle.

The inner or sternal portion of the gland derives its blood-supply from the internal mammary branch of the subclavian artery. From the main trunk of the internal mammary artery branches are given off which perforate the second and third intercostal spaces and enter this segment of the breast. From the internal mammary artery are given off intercostal branches, which also send off small arteries to this portion of the gland. The deep epigastric artery from the external iliac forms an anastomosis with the internal mammary artery from the subclavian, and from this anastomosis the deep epigastric sends twigs to the sternal portion of the gland.

The posterior portion of the gland derives its blood-supply from the aortic intercostals which come off from the thoracic aorta. In the gland itself the return circulation is carried on by venæ comites of the corresponding arteries, but upon the periphery of the gland and the skin overlying the breast some veins empty into a plexus around the areola and nipple, while others empty into the cephalic vein, and still others, ascending and crossing the clavicle, enter the external jugular and subclavian veins.

The *nervous supply* of the breast is derived from filaments of the sympathetic and the thoracic branch of the brachial and cervical plexuses, also from the second to the sixth, inclusive, branches of the intercostal nerves. The nervous supply of the integument covering the gland is also derived from filaments given off from the above-mentioned nerves.

The rich inosculations of the superficial integumentary branches of the breast with those of the shoulder, axilla, scapular and inner surface of the arm serve to explain the pain which is transmitted to these parts

in malignant diseases of the mammary gland as well as in certain benign tumors and neuroses.

The *lymphatics* of the breast are very numerous, and are superficial or deep. The former are cutaneous, and one set, the axillary set, emerge from the nipple and glands of the skin and pass over the anterior and outer surface of the gland beneath the integument, where they enter the cribriform openings in the axillary fascia to join the axillary ganglia (Fig. 429). From these axillary nodes they descend to other ganglia

FIG. 429.

Lymphatics of breast and axilla (Cooper).

situated between the third and fourth ribs, and form a plexus around the axillary vein an inch below the clavicle. They ramify around the axillary vein, and finally form a duct which is situated upon the inner side of the vein between the first rib and the clavicle, and eventually empties into the vein formed by the right jugular and right subclavian vein. Upon the left side the same arrangement takes place, and the main absorbent trunk empties into the vein formed by the junction of the left jugular and the left subclavian veins at the point near which the thoracic duct terminates. In addition to this, a few superficial lymphatic vessels pass behind the axillary vessels and plexus and empty into the lymphatic ganglia of the arm, and finally ascend again through nodes to empty in the same way as the other set.

The other superficial, or sternal, set is subdivided into two groups. One group of lymphatics penetrates the second intercostal space and intercostal muscle, enters the anterior mediastinum, and, following the course of the internal mammary artery and vein, joins the lymphatic nodes in the anterior mediastinum. The other group of lymphatics enters the fourth intercostal space, likewise penetrates the intercostal muscle, and joins the same set of lymphatic nodes. Upon the right side these lymphatics anastomose with those from the liver, and finally both sets empty into the vessel formed by the junction of the right jugular and

subclavian veins, and those upon the left side into the corresponding vessel. The arrangement of these superficial lymphatics has been described at length, because it will serve to explain the dissemination of malignant disease from the breast into the axilla, mediastinum, and liver.

The deep set of lymphatics takes its origin from the mucous membrane of the milk-ducts and acini, and forms a rich plexus of lymphatics which finally join those lymphatics in the axilla derived from the superficial group. The deep set on the inner side of the gland joins those of the superficial group and enters the mediastinum. Another deep set of lymphatics enters upon the posterior and outer surface of the gland, and, passing through the intercostal muscles and joining lymphatics which accompany the aortic intercostal vessels, empties into the thoracic duct, while upon the posterior and inner surface of the gland a set joins the lymphatics belonging to the internal mammary artery and empties into the ganglia situated in the anterior mediastinum.

The general arrangement of these lymphatics serves to explain the dissemination of malignant disease in the axilla or arm or the infection in the cervical or subclavian or scapular glands when the neoplasm affects the outer or upper quadrant of the breast. It also offers an explanation of the dissemination of malignant disease in the mediastinum, intercostal spaces, ribs, and liver when the disease originates primarily in the inner or sternal quadrants.

The anatomical arrangement of the lymphatics likewise explains the metastatic deposits in the pleura, ribs, and lungs, and, through the aortic intercostals, the dissemination into the spinal cord itself.

The surgical anatomy of the axillary space should be briefly discussed in this connection prior to a study of the surgical diseases of the gland and nipple. This seems necessary, because a thorough knowledge of the anatomy of the axilla is essential to a complete understanding of the surgical diseases and operations upon the female breast.

The surgical relations of the axilla are most important, since a radical operation upon the breast cannot be undertaken intelligently without an accurate knowledge of the situation of the large vessels and nerves, as well as the anatomical arrangement of the lymphatics.

The skin covering the axilla is pigmented and contains many sebaceous glands, much hair, and a rich set of lymphatic vessels. The skin is closely connected with the underlying axillary fascia. In the centre of the axillary skin is a small area containing, as Sappey has pointed out, tubular glands similar to sweat-glands, the secretion of which gives in certain individuals a most characteristic and disagreeable odor. The writer has seen two cases of primary malignant disease start in these glands. The breasts were not affected.

The inner wall of the axilla is comparatively free from important vessels, but contains the long thoracic nerve, which should be avoided in operating in this field. The outer wall of the axilla contains the large vessels and nerves. These important structures are especially exposed to danger in extirpating axillary glands if the head of the humerus is pushed into the axillary space by elevation of the arm over the head during the performance of amputation of the breast.

The posterior wall of the axilla must also be approached with great care, since the subscapular vessels and nerves lie in close contact with it.

In dissecting the axilla care should be observed not to place the tissue in too much tension, since this condition has a tendency to obscure the veins by causing them to collapse, thus giving to them an appearance of fascia placed upon the stretch. The entrance of air into a wounded vein must also be borne in mind, and measures which have already been described be employed immediately. Tearing glands out with a certain amount of violence is fraught with the danger of cellulitis and abscess during the repair of the wound. Habersham reports a case of a negress, aged thirty-eight, who had a gland in the axilla from which milk was drawn by a trocar. This occurred during the time she was nursing her sixth child. This gland was a supplementary mammary gland. Dr. Hare also reports a case in which an axillary gland secreted milk. There was no nipple, but the milk exuded through one of the openings of a sweat-gland. This patient was presented to the University College Hospital in Philadelphia in 1860.

MALFORMATIONS OF THE BREAST.—Before describing the functional inflammatory and organic diseases of the female breast a few remarks upon the abnormalities and malformations of the gland and nipple are pertinent.

Amazia (*a* = privative + *μαζός* = breast) denotes absence of the mamma. This anomaly only occurs in the female, and most frequently upon the right side. This condition may be congenital, in which case there is no trace of a gland; or acquired, in which case the gland itself fails to develop. The congenital form is very rare, and is associated with arrest of development of the sexual organs or the thorax. It may be unilateral or bilateral. The acquired variety is usually the result of some traumatism which has led to abscess or suppuration, so that the gland itself has been completely or partially destroyed by the suppurative process.

Micromazia (*μίκρός* = small + *μαζός* = breast) constitutes an imperfectly developed breast, and arises from various causes, such as arrest of development of the chest-wall or of the sexual organs, or it may arise from idiopathic causes or be the result of a chronic empyema. Warren in his interesting book on *Surgical Observations* reports two cases of infantile uterus with absent or rudimentary ovaries in which micromazia was present, and Laycock has pointed out, from a thorough investigation of the subject, that absence of the uterus may be attended with a normal development of the breast, provided the ovaries are present, and draws the inference that the development of the breast is associated with ovarian rather than uterine growth.

Pleiomazia (*πλείων* = many + *μαζός* = breast) signifies supernumerary glands. There is a case reported in which five mammary glands existed, from all of which milk was secreted. The supernumerary glands are usually situated in the axillary and in the lower mammary regions. There have been cases reported where the glands are said to have been situated in the inguinal region and upon the outer aspect of the thigh. In over 90 per cent. of the cases supernumerary mammæ are situated beneath the site of the pectoral glands and verge toward the median line. Atavism is assigned by Orth as the explanation of the supernumerary breasts. These anomalies seem to follow along the course of the internal mammary and deep epigastric arteries, from which they derive their vascular supply. In

the case of supernumerary mammary glands the function of lactation has been performed. In a case of supernumerary mammæ involving the thigh the child is reported to have suckled the gland while standing by the side of the mother. It is stated that King Henry VIII. had Annie Boleyn beheaded on account of a supernumerary breast.

Darwin has pointed out the fact that supernumerary mammary glands, as a rule, have fixed positions in the body, and that these places correspond in the bimastic to those in which the glands are situated in the polymastic animals.

Hausemann tabulated 262 cases, among which the female supplied the greatest number. This, he claims, supports the theory of their origin being due to reversion, and strengthens also the theory that our early progenitors were polymastic and produced several young at one parturition.

Williams states that on scientific authority "our early progenitors had at least seven pair of mammæ on the ventral aspect of the trunk; of these only the present pectoral pair have survived."

Agalactia (*a* = privative + *γάλα* = milk) is a condition characterized by either the entire absence of the secretion of milk or else a marked diminution in the quantity and quality, so that it is of little, if of any, value. In these cases the breasts usually present the normal shape and size as far as external appearances are concerned, but the functional activity is wanting. Agalactia may be due to some inherent defect in the glandular development, to atrophy of a previously developed gland, to the consequences incident to an early attack of inflammation resulting in destruction of the gland, to an excessive period of previous prolonged lactation, to an hypertrophy of the gland, to pressure-effects due to the presence of a tumor, or to the administration of large doses of the iodide of potash. It is said to be limited to the civilized races, as the condition is unknown among the primitive races. Harlan reported a case in which a woman had borne thirteen children and never had any milk in her breasts.

The **treatment** of agalactia should be instituted at once, in order, if possible, to secure a flow of milk. In cases of amazia of course nothing can be accomplished. In cases where the breasts appear normal warm fomentations can be applied to encourage the flow of blood to the breasts, and the child should be placed at the nipple so as to stimulate the secretion of milk. Electricity and massage to the mammary, ovarian, and spinal regions have been largely extolled.

Galactorrhœa (*γάλα* = milk + *ῥέω* = to flow) is a condition characterized by a superabundant supply of milk. The excessive quantity may flow at one time, or else over a prolonged period after discontinuance of the use of the gland. It is reported that as much as seven litres have been secreted in twenty-four hours. Both glands are usually involved, although there are cases reported in which the condition was unilateral. The cause of the trouble has been ascribed by some to a partial failure of the inhibitory nerve-supply of the breast, by others to the excessive use of alcohol and the want of proper exercise in conjunction with over-eating.

In connection with galactorrhœa might be mentioned a form of lactation occurring at other periods than pregnancy. The writer while an

interne in the foundling hospital on Randall's Island observed several cases in which colostrum was secreted from the mammæ of male as well as female infants. At puberty and at the catamenial epoch a milk-like fluid often is secreted from the breasts. This same condition may arise in connection with cystic disease of the breast, with the important difference that the analysis of the fluid is not the same.

The **treatment** of galactorrhœa has reference to the cessation of the lacteal function, the return of menstruation, the improvement of the general health by the administration of iron, quinine, arsenic, and strychnia, and, finally, to the removal of any contributing cause. Anything which conduces to the general welfare of the mother should be adopted, such as change of air, sea-bathing, riding, moderate exercise, and good, nutritious diet.

Galactocele (γάλα = milk + κήλη = rupture) is a cyst which is situated in the connective tissue of the mammary gland. Occasionally a galactocele is found in the posterior part of the gland with healthy glandular tissue overlying it, so that the tumor-mass may appear nodulated or lobulated. The milk which is contained within the cyst is derived from the rupture of the walls of a lactiferous duct or collects by mechanical obstruction leading to dilatation of the duct. The fluid in the cyst, instead of pure milk, may be cream or a substance akin to butter or cheese. These variations depend upon some changes which occur in the milk arising from the extravasation into the connective tissue of the gland.

Galactocele, therefore, depends upon the functional activity of the gland, since it is usually during lactation that this condition arises. The size of the tumor varies according to the milk-secreting capacity of the gland, as well as to the amount drawn from the organ by continuous suckling, and is also influenced by the absorption of the watery elements of the milk and the coagulation of the residue.

The galactocele may be situated near the nipple, in which case it is usually solitary, or it may be found in the substance of the gland itself, under which circumstances the cysts are usually multiple.

The **diagnosis** of galactocele is made from the sudden appearance of a non-inflammatory swelling in the breast—as a rule, during a period of lactation. There are a few recorded cases of galactocele which developed before or after the period of functional activity of the gland. Atlee reported a case in which the galactocele developed sixteen months before parturition, and Bouchacourt a case occurring in a woman twenty-four years after her last confinement. Pain is a symptom of galactocele, but it usually is the result of the weight and tension of the swelling. If the contents are fluid in character, fluctuation is present. If the contents are semisolid, a peculiar putty-like feeling is transmitted to the surgeon's fingers during the manipulation of the swelling. If the mass is firm and condensed, a hard tumor is felt, giving the characteristics of a fibroma, adenoma, or sarcoma. The absence of adhesion of the skin and retraction of the nipple are important points to consider in diagnosticating galactocele from other tumors of the breast.

The nipple usually discharges a small quantity of milk from the mechanical distention of the cyst. During lactation this sign is of no value, but it would be pathognomonic in a case of galactocele occurring before or after lactation.

The treatment of galactocele is purely surgical. The milk will not become absorbed, and the constant swelling upon the glandular structure will produce atrophy of the gland. Besides, the tendency of the galactocele is to grow, and thus the swelling soon becomes sufficient to cause inconvenience and discomfort from its pressure-effects.

Aspiration of the cyst may be tried as a palliative measure, and in case of failure incision into the cyst, with complete evacuation of its contents and with subsequent drainage, is indicated. The opening into the cyst should be free and large, and attended with every aseptic precaution, since without the former a small and troublesome milk fistula is likely to arise, and without the latter precaution an abscess may follow. The avoidance of the milk fistula is important, because the healing of it is exceedingly difficult, owing to the escape of milk from the gland; the prevention of sepsis is also important, because the gland can be entirely destroyed by such an accident.

WOUNDS of the breast are occasionally observed. They may be the result of gunshot or stab wounds or the effects of violence. Ecchymosis is found in all of these cases. Simple wounds of the breast, unless occurring during lactation, present no unusual characteristics. If they are received during the functional activity of the gland, suckling from the breast must be suspended. Severe wounds often are tedious to heal on account of the various structures involved in the composition of the gland.

The blood-clots derived from trauma of the breast, according to Rokitansky, may give rise in the future to connective-tissue neoplasmata.

In certain individuals spontaneous hemorrhage occurs in the glands during menstruation. The seat of the hemorrhage is subcutaneous and not interstitial, but in rare cases may involve the glandular structure. This vicarious ecchymosis gives rise to no trouble, as the extravasated blood soon undergoes absorption.

NEUROSES OF THE FEMALE BREAST include the different varieties of mastodynia induced by menstrual changes, pregnancy, hysteria, gout, and rheumatism. At the establishment of menstruation, as well as at its monthly return, peculiar sensations are often experienced in the breast. These sensations in some cases amount to severe pain, which may be localized in the gland or it may shoot through the gland into the shoulder, side, and arm. With the arrest of menstruation the symptoms usually subside and require no treatment. At the onset of pregnancy the same condition may arise, and paroxysms of pain may occur from time to time during the period of pregnancy. The condition seldom calls for active treatment. At the beginning of the menopause the same disagreeable symptoms may appear in the breast, and in neurotic women give rise to the belief that they are suffering from carcinoma of the breast. The writer has seen mastodynia of a rather severe type occur in women who suffered from gout and rheumatism. The breasts were exquisitely sensitive to the touch. Sharp pains which were lancinating and stabbing in character darted through the swollen breasts and caused the patient much physical and mental suffering. In hysteria the breasts often become sensitive and painful, and the expression of suffering is often most marked.

Upon examination of the breasts there is experienced a sensation of fulness, and often an induration exists which blends with the surrounding glandular tissue. The induration often eludes the fingers, and the pain sometimes is described as excruciating by the patient. In the cases in which induration exists the thickening is akin to that seen in orchitis, while the same physical symptoms may exist without the presence of an induration and depending entirely upon an exaggerated hysterical condition.

The **treatment** of neuroses of the female breast, whether purely functional or attended by a certain degree of induration or depending upon some diathesis, consists in removing the exciting cause and in improving the general health and correcting the diathesis. The cases which are dependent upon catamenial disturbances and pregnancy and the climacteric period require but little medical attention. The cases of mastodynia depending upon gout and rheumatism require a thorough treatment with the salicylates and colchicum, in conjunction with a course of baths and the restriction of the diet to an antigout or antirheumatic one. The topical application of the oleate of mercury and morphia, alternating with the iodide-of-potash ointment and the emplastrum hydrargyrum cum ammoniaco, may be tried. In the use of any or all of these local remedies caution should be observed lest a too violent action follow their employment.

The INFLAMMATORY AFFECTIONS OF THE FEMALE BREAST derive their chief importance from the fact that they may eventually lead to the development of malignant disease. Enlargements of the breast of inflammatory origin usually follow upon pregnancy, a period at which a malignant tumor seldom appears. The writer has seen, however, malignant disease, notably sarcoma, held in abeyance by pregnancy, but immediately after confinement start up and grow with unparalleled rapidity. In 150 cases of mastitis collected by Martin, with the exception of 8 or 10, all occurred during lactation. These inflammatory affections may be classified into several varieties, among which may be mentioned acute, chronic, syphilitic, tuberculous, and chronic interstitial mastitis.

Acute mastitis may occur in the breast at any time from early infancy to extreme old age. In the infant it is usually provoked by traumatism or else by rough manipulation on the part of the nurse in her attempts to excite a secretion from the miniature gland. The friction or rubbing of the breasts by the nurse is especially apt to occur in those cases in which a few drops of colostrum exude from the nipple, and the nurse's over-anxiety to squeeze out all the secretion from the gland excites a violent inflammation which may lead to suppuration.

If acute mastitis arises at the period of puberty, it may be likewise caused by an injury to the hypersensitive breast or to an irritation caused by the tight-fitting corset, or it may be the result of those changes incident to the appearance of menstruation. At this time the mammæ become swollen and tender and engorged with blood. The nipple is exquisitely sensitive, and the areola becomes darkened by the deposit of pigment. When the breast is in this unusual state of functional activity an injury or any disturbance of the natural evolution of the breast is apt to cause an inflammation which may undergo resolution or lead to acute suppuration. If the acute mastitis occurs

during the period of lactation, at which time the great majority of these cases are observed, it may be also caused by traumatism or be due to some structural defect in the nipple or lactiferous ducts, or to a too prolonged period of suckling, or to a sudden cessation of the function, to the baneful use of a milk-pump, or to the changes induced in the gland by weaning, or, finally, to the presence of micrococci which have entered the ducts through the nipple. The writer feels certain that this has been the cause of acute mastitis in certain cases which he observed while an interne in the foundling hospital. The nipple is often a nidus, like the umbilicus, for the collection of micrococci, and their introduction into the ducts acts as the cause for the development of acute mastitis.

The **signs and symptoms** of acute mastitis must necessarily vary somewhat according to the age and the functional state of the gland. In general, it may be said that they include a sense of fulness, the presence of shooting pains in the breast, axilla, and arm, the existence of well-marked induration and œdema; and these signs are usually accompanied by a red, tense, œdematous skin over the affected portion of the gland, with an oblong tumor if one lobe only is involved, or a circumscribed tumor of considerable size if several lobes.

Increase of temperature, a rigor, and acceleration of the pulse are among the constitutional symptoms. The severity of the signs and symptoms depends upon the state of the gland. In the infant the attack is usually less severe than during lactation.

It occasionally happens that acute mastitis involves the posterior part of the mammary gland or the cellular tissue underneath the gland, in which case the constitutional symptoms are the same, but the local signs vary in that there is less superficial swelling and œdema, but more deep-seated effusion and a greater projection forward of the entire gland. It must be borne in mind that acute mastitis may attack one lobe of the breast or the entire gland, or it may involve the connective and areolar tissue which surrounds the organ, or even the retromammary tissue; in which case the pus gravitates so as to present a point of fluctuation at the lower margin of the gland.

The **treatment** of acute mastitis in the infant is prophylactic rather than surgical. The presence of a little colostrum is attended with no ill results, provided friction to the breast is not employed, and by care and non-interference suppuration may be avoided. Resolution is to be secured, if possible, by removing all kinds of friction, by the application of some soothing lotion like lead-and-opium wash or Goulard's extract, and by the prevention of any manipulation of the breast. If suppuration ensues, an incision should be made which radiates from the nipple and is parallel with the lactiferous ducts, and a rigid antiseptic dressing applied. Any cavities should be scraped out gently and irrigated with some antiseptic solution.

The management of acute mastitis at the time of puberty consists likewise of the removal of all kinds of friction and the discontinuance of any manipulation; the application of lead-and-opium wash or belladonna ointment to the gland; the free administration of salines; the supply of good nourishing food and the use of tonics; the fixation of the pectoral muscle by bandaging the arm to the chest; and the support of the gland by gentle compression. If suppuration follows, free incis-

ion in the manner already described, and the application of an antiseptic dressing and drainage if necessary, are to be employed.

The care of acute mastitis during the period of pregnancy consists in supporting the breasts by equable compression while the patient assumes the recumbent position, gently stroking the breast toward the nipple at the time when the bandages are changed, together with the administration of salines. If suppuration should ensue—which is not likely, however—the same plan of treatment must be adopted as has been laid down for suppuration in the breast when it occurs at other periods.

Finally, the treatment of acute mastitis during the period of lactation involves a different principle, since the cause of the trouble is usually due to the presence of micrococci which gain entrance to the ducts and the acini by the nipple, or by the skin lymphatics, or by the mouth of the infant, or by the handling of the breast by the mother, whose fingers may carry infection, or, finally, by blood proceeding from the kidneys, which may also be infected. Absolute cleanliness is essential to prevent this manner of infection.

In a case of acute mastitis of a puerperal variety in which the patient died from pyæmia Gross reports that he found staphylococcus pyogenes aureus and albus in great abundance.

The nipples should be carefully examined to ascertain if there is any mechanical obstruction to the free flow of the milk from the gland, also to see if there is any malformation, such as retraction, or any local disease, such as eczema, ulceration, warts, etc., or any local disturbance, as a crack or fissure or an areolar abscess. Next, the lobules and ducts should be felt to see if there is any accumulation of milk which by its tension causes the local inflammation. The local retention of milk must be relieved either by stroking the breast gently toward the nipple, by the application of the child to the breast, or by the use of a suction-pump, which should be employed by the surgeon and not left to the indiscriminate use of the nurse.

If the acute mastitis occurs at the close of a long period of lactation, suckling should be discontinued, and, if suppuration is not present, a change of air recommended with every hygienic precaution. Suppuration, unfortunately, is likely to ensue in these cases, because the constitution of the patient has been greatly overtaxed by prolonged lactation, and she is unable in this state to resist the tendency to the development of inflammatory processes. Suppuration must be managed according to the rules of antiseptic surgery.

Chronic mastitis is an affection of the breast which is usually associated with the phenomena of pregnancy. It is extremely rare to find chronic mastitis except in relation to lactation, and especially at its close. When it is present apart from this functional activity of the gland, it has been attributed by Lucas-Championnière to the injurious effects arising from the irritation due to an ill-fitting or too tight corset. Robinson believes that this theory is hardly tenable, since the seat of the induration is in the superior segment of the breast in the majority of the cases. The induration may be deep-seated or superficial. The possibility of carcinoma must be always considered in cases of chronic mastitis with marked induration. Such a mistake would jeopardize the life of the patient, as success can only be secured in carcinoma by early operation.

The **signs and symptoms** vary according to the situation. If superficial, the induration has a well-defined and circumscribed margin, and the skin is not adherent or red, but it may be slightly œdematous and the nipple retracted. The tumor is painful to manipulation, and gradually increases in size. If the induration is deep-seated in the gland, the skin may be drawn over the lump and the nipple somewhat retracted. The induration often breaks down and thick pus is found, and in this case there is deep-seated elasticity in the swelling. The axillary glands are usually unaffected.

The **differential diagnosis** of chronic mastitis with induration must be made from other varieties of mastitis and from neoplasms. Neoplasms are differentiated from chronic mastitis with induration by the age of the patient, by the absence of lactation, by the presence of glandular involvement, especially in carcinoma, by adhesion of skin and retraction of nipple, by the extreme hardness of the induration without a well-defined margin, and by the rapidity of the growth. In conclusion, the important clinical fact must not be lost sight of that any and all of these various indurations may remain innocent for a period of years, but at the time of the menopause these masses may undergo malignant degeneration. Carcinoma has been proved to arise from such conditions.

Tuberculous mastitis is differentiated by the absence of a well-defined margin to the tumor, which is generally unilateral; by the presence of pain or tenderness upon manipulation; by the associated axillary and glandular involvement; by the presence of pus containing cheesy flakes; and by the presence of the bacilli of tuberculosis associated with a tuberculous history.

Interstitial mastitis is diagnosticated by the absence of redness and œdema of the skin, by the freedom from pain and tenderness on manipulation, and by the bilateral character of the affection.

Syphilitic mastitis is to be differentiated by the history of infection; by the infiltration of the connective tissue; by the absence of pain on manipulation; by the healthy appearance of the skin at first, but subsequently by its adhesion; by its dark color, and, later on, by its red appearance; by the presence of ulceration; by the possible concomitant axillary enlargement; by the presence of gumma elsewhere; and by the gradual diminution in size and the disappearance of growth after two months' administration of the iodide of potash. The skin is not indented and infiltrated, as it is in carcinoma.

The **treatment** of chronic mastitis with induration depends upon the conditions present. If there is fluctuation, an aseptic exploring needle should be introduced. If pus is obtained, free incision, aseptic irrigation, and drainage should be employed. If the pus is too thick to pass through the needle, and yet the diagnosis is tolerably certain that an inflammatory mass is present, a free exploratory incision can be made and the abscess and the wound healed aseptically.

Chronic interstitial mastitis is a form of inflammation usually affecting the outer half of the breast, and is generally observed in married women who have reached the menopause or between the ages of forty-five and fifty. It is seldom seen in young women. The induration is usually limited to a few of the lobules, and has been called by Beck

chronic lobular interstitial mastitis. It is identical with the chronic mammary tumor of Sir Astley Cooper or the partial hypertrophy of Velpeau.

The lobules appear white and glistening upon section. The fibrous induration is infiltrated with leucocytes. There is also present débris composed of epithelium which has undergone fatty degeneration. This growth often forms the nucleus of a carcinoma. The chronic interstitial mastitis may be circumscribed or diffuse. In the latter form there is a rich development of fibrous tissue. Cysts are often formed in the meshes of the fibrous tissue which has by pressure and consequent absorption displaced the gland-substance. In the former or circumscribed variety nodules about the size of a hickory-nut are found interspersed between the normal gland-lobules. If the nodules are larger, there is usually a cyst found in the centre of the mass. Kŏnig regards these nodules as inflammatory new formations which become encapsulated.

Chronic interstitial mastitis may be caused by traumatism or by irregularities of menstruation. Celibacy has been assigned as a cause by Robinson, who states that "of 17 cases, 12 were in single women; of the 5 married, 3 were sterile, 1 had 4 children, and the other not known." Chronic interstitial mastitis by its pressure-effects produces obliteration of the gland-tissue, and forms a sclerosed mass which undergoes calcareous degeneration by the deposit of lime salts in the stroma, forming a tumor of stony hardness, two examples of which have been reported by Grosse.

The **treatment** of chronic interstitial mastitis is amputation of the breast, since no other measure will be of any avail. The tumor usually enlarges until, by its pressure-effects, pain, sloughing, and ulceration follow; and in those cases in which such a termination is not prevented by operation carcinoma is likely to develop in the nodule.

Syphilitic mastitis is not so frequent as some of the other varieties. The disease may be found in primary, secondary, tertiary, or hereditary syphilis, but usually in the secondary. If primary, the mastitis is caused by some abrasion of the nipple in consequence of the mother suckling her syphilitic infant or a wet-nurse suckling an infected babe. If secondary, the mastitis is usually caused by mucous patches or some other skin-manifestation of syphilis. If tertiary, the mastitis usually is due to the presence of a gumma. If hereditary, the mastitis usually terminates in an atrophy of the gland. Whatever form of syphilitic mastitis is present, Heath has wisely suggested, as quoted by Williams, that "the surgeon should keep his eyes open and his mouth shut."

The selection of a wet-nurse requires a more thorough examination, since the infection of an infant by a syphilitic wet-nurse is a most serious calamity, and for which a surgeon would be held responsible.

Syphilitic mastitis may be manifested in the form of a typical gumma or as a diffuse dissemination in the gland. The disease is generally associated with the signs of syphilis in other parts of the body. Plate XIV. Fig. 1.

If the tumor is circumscribed, the gumma involves the lobules; if diffuse, the connective tissue of the gland. The gumma exhibits the same phenomena in the female breast as in the testicle. The induration

PLATE XIV.

Fig. 1. Gummata of Breast. (Taylor.)
Fig. 2. Chancre of Nipple. (Taylor.)
Fig. 3. Paget's Disease of the Nipple, showing the Eczema followed by

may be painless and ill defined at the beginning, and as it enlarges become tender and more circumscribed. The axillary glands are usually enlarged. The nipple will not be affected if the gumma is situated in the periphery of the gland, but may be retracted if the mass takes its origin from the centre of the gland. In the late stages the growth may form adhesions to the skin, and the color is changed from the normal appearance to a dusky hue, and later to a red color. The tension of the gumma finally causes the integument to slough and ulceration becomes established. The ulcer has brownish-red edges and is very deep. The gumma may break down and form an abscess, or the entire mass may slough and come away from the breast. In this respect the history of the gumma is entirely different from the course which carcinoma runs. The writer examined a typical specimen in Péan's collection of gummata in which the ulerated mass had existed for six weeks in a woman who had been syphilitic for twenty-five years.

In connection with syphilis of the breast it may be mentioned that chancres are occasionally observed. The writer saw in Fournier's collection a specimen showing two chancres upon the right breast upon the areola at the base of the nipple. There was also a well-marked axillary ganglion of the same side. Péan has also in his collection a specimen of chancre of the left breast. There are many other cases reported, but it is unusual to find the pathological material to examine. Plate XIV. Fig. 2 shows a chancre of the breast, the drawing of which is kindly furnished by Dr. R. W. Taylor. These chancres form a plaque upon the nipple. The ulcer during lactation is erosive, and subsequently it becomes encrusted. Upon the areola the ulcers may be elevated or depressed below the level of the skin. They are usually multiple and found upon both breasts. Both upon the nipples and areola indurated fissures are found.

Chancres of the breast are caused by infants suckling with mucous patches, or even with hard chancres, in the buccal cavity. The latter are infected by syphilitic persons kissing the infant, and it in turn infects the breast of the mother or wet-nurse. Dr. R. W. Taylor reports two cases of chancre of the breast in men whose breasts were kissed by women with mucous patches. The chancre is solitary in about 50 per cent. of the cases.

The **treatment** of syphilitic mastitis is very simple, since the administration of iodide of potash or soda is indicated. The remedy should be given in gradually increasing doses, and continued for at least two months, or longer if necessary. A local application to the breast of mercurial ointment, alternating with belladonna ointment, has been highly recommended in connection with the internal administration of the iodides and mercury. It is seldom that surgical interference becomes necessary. The gummatous ulcer may be irrigated with an antiseptic solution in conjunction with the constitutional treatment. If this treatment fails, amputation of the breast is indicated—a procedure, however, seldom called for in this disease of the breast.

Tuberculous mastitis is a disease that was usually known under the name of scrofulosis. It occurs during the middle period of life, and is usually secondary to other tuberculous lesions, notably pulmonary phthisis. If the disease exists as a primary affection, it is said to be

due to hereditary causes. There have been cases in which the disease is reported to have followed an authentic history of traumatism of the breast. While the majority of cases seem to be caused by pregnancy and lactation, Robinson reports two cases in which tuberculous mastitis occurred in connection with indurations which survived without absorption through several pregnancies. The disease may be circumscribed or diffuse. In the circumscribed variety the induration has no distinct or well-defined edge and sends off prolongations into the gland. The tumor moves with the mamma over the pectoral muscle. The adhesion of the skin is usually absent, and the retraction of the nipple only occurs when the nodule is situated in the centre of the gland. In the diffuse variety the induration consists of multiple infiltrations, with here and there normal breast-tissue intervening between the indurations. Ohnacher states that in all probability the diffuse variety is derived from the infection of a circumscribed tuberculous mass.

The **clinical history** of tuberculous mastitis is interesting, as it presents different phenomena from the other varieties of mastitis. If the tuberculous mastitis is a primary disease, the infection may arise from some abrasion of the nipple and be carried by the lactiferous duct into the connective tissue. The tuberculous mastitis may also extend by contiguity from a localized mass in the breast. In primary tuberculosis of the breast with no involvement of the adjoining structures or glands the infection is in all probability by hæmatogenesis. The disease may run an acute or a chronic course. The induration shows early manifestation of breaking down, with the production of thickness and inspissated pus, which burrows its way through channels which afterward form permanent fistulæ which open into irregular cavities. The indurations at first are found without pain or tenderness, which is a characteristic feature of this variety of mastitis. In the later development pain of an intermittent character may be experienced. Associated with this local condition the constitutional symptoms of general tuberculosis develop, provided the focus is not a primary affection.

The **diagnosis** of tuberculosis of the female breast can only be made with absolute certainty by an examination of some of the tissue in which the presence of bacilli tuberculosis reveals the true nature of the affection.

The tuberculous mastitis must be differentiated from the other varieties of mastitis as well as from neoplasms of the breast. The reader is referred to the points in differential diagnosis described under *Chronic Mastitis* for information upon this subject.

If the disease is primary in the breast and it is operated upon early, with removal of the axillary glands, the results are most encouraging. The accompanying illustration, kindly furnished by Dr. Lange, shows a case of tuberculous mastitis in which he operated. There were several tuberculous abscesses, and the entire breast and axillary glands were removed together with the skin. The large wound was then covered over by skin-grafts (Fig. 430).

The **treatment** of tuberculous mastitis involves amputation of the breast, since if a mass of this nature be left in the gland it is likely to cause secondary infection of lymphatics of the axilla, and even to extend to the lung, liver, or mediastinal glands. If it is secondary, the mass

should still be removed, provided the other lesions are not too far advanced. A child should never be permitted to suckle from a breast the seat of tuberculous disease, since the danger of infection is without doubt established.

A study of the few cases operated upon show that recurrence is likely to take place in about 50 per cent. of the cases.

FIG. 430.

Tuberculosis of breast (Lange).

MAMMARY ABSCESSES may be acute, hot, or phlegmonous, or chronic, cold, or tubercular. The former are generally associated with the function of lactation, while the latter may or may not be connected with the functional activity of the gland.

Acute mammary abscess may be situated in the substance of the gland itself, in which case it is found usually in the axillo-inferior quadrant, and is termed an intramammary abscess, or it may be found in front of the gland between it and the integument, under which circumstances it is termed an antemammary abscess, or, finally, it may be situated behind the gland, between it and the pectoral fascia and muscle, in which case it is called a retromammary abscess.

It is at the time of functional activity of the breast that abscesses are most likely to occur. In the new-born, at the age of puberty, and during lactation are the periods when these inflammatory attacks take place.

In the new-born the abscess is apt to arise in consequence of improper manipulation of the miniature breast by the inefficient and ignorant nurse or of traumatism. At puberty this affection may arise in the male as well as the female, and during lactation 3 to 6 per cent. of the cases of confinement.

The **causes** of mammary abscess depend somewhat upon the situa-

tion. Any anatomical deviation of the nipple from the normal standard may cause an abscess during lactation. Birkett reported that out of 97 cases of acute mammary abscess there was imperfect mammillary development in about 50 per cent. of the cases. Again, acute mammary abscess may develop in consequence of the presence of the micrococci, which are found in the skin over the breast, areola, and nipples. It was formerly supposed that retention of milk alone in the ducts would give rise to abscess of the breast, but experiments have shown that ligaturing the nipples and mechanically preventing the flow of milk in the breasts of lower animals did not give rise to abscess unless the pus-producing microbes were present. Bacteria or ptomaïnes are the *sine quâ non* for the development of mammary abscess. These microbes may come from the hands of the nurse or the mother or from the mouth of the infant. Escherich believes that bacteria in connection with the lochia may gain access to the blood and to the milk in the same manner as certain forms of bacteria are found in the blood and urine. Bacteria in milk have been demonstrated by Bumm in patients with puerperal inflammation of the breast. The staphylococcus pyogenes aureus and albus have been found in the milk, and staphylococci have been demonstrated in the glandular structure. Bumm believes that in mammary abscess the microbes cause the milk to ferment, so that the casein undergoes coagulation and the sugar is changed into lactic and butyric acids, and as a consequence these coagula filled with bacteria excite irritation in the gland-tissue which leads to inflammation in the surrounding tissues, which are filled with leucocytes and microbes. The cells lining the lactiferous ducts undergo changes and the epithelium is cast off. In this manner many foci of infection originate which finally coalesce to form an abscess-cavity. The abscess may be arrested by the presence of the leucocytes, which drive to the wall the microbes of suppuration. It is thus evident that in mammary abscess the infection is a mixed one in the human being, although it has been proved that there are *specific* germs which cause mammary abscess in some of the lower animals—for example, in sheep and cows.

These germs may gain access to the breast through a crack or fissure in the nipple or through the blood-vessels. The lymph-channels convey the streptococci and the milk-ducts the staphylococci. The fact must not be overlooked that the staphylococcus pyogenes albus may occasionally be found in normal milk.

If the mammary abscess is situated in the interior of the gland, the inflammatory process is the result of the introduction of the bacteria of suppuration into the gland through the openings in the nipple, by the blood-vessels or lymph-channels or ducts. Under these conditions the hyperæmia and the irritation of suckling may cause the abscess. This variety of abscess may occur during lactation or in consequence of a too prolonged period of nursing, or it may proceed from fissures in the nipple or from ulcers situated upon the areola or nipple.

In the intramammary abscess usually a single lobule is affected, and an early incision and antiseptic irrigation and drainage arrest the process. If an exit is not provided, the pus finds its way into other lobules until the abscess is extensive and diffused. Under such conditions the abscess usually points, and one incision is insufficient, because

the trabeculæ springing from the inner surface of the capsule furnish separate compartments which can only be drained by multiple incisions radiating toward the nipple, so as to cut parallel with the ducts.

If the abscess is situated in front of the gland and just beneath the skin of the nipple and areola, it is caused by cracks, fissures, or eczema of the nipple or from some injury to it.

If the abscess is situated behind the gland, the cause may be due to a septic infection through the nipples, or to some traumatism affecting the retromammary cellular tissue, or to caries of the rib, or even to a pleurisy. The infection can gain access to the loose cellular tissue through the lymphatics, which, as has been already demonstrated, are in communication with the lymph-nodes found in the pectoral fascia and muscle.

The **signs and symptoms** of mammary abscess depend upon the situation. If the abscess is in the gland, pain, which is a prominent and early symptom, is severe and increases in severity, owing to the tension. In the beginning it is sharp and lancinating in character. The other cardinal symptoms of abscess are wanting in the early stages, because the process is confined within fibrous compartments, and the manifestations of fluctuation, œdema, and redness are delayed.

The presence of great pain in a breast, accompanied by constitutional symptoms during lactation, points to the development of acute abscess. The pain and constitutional disturbance may last for days, or even weeks, before any local manifestations of acute abscess. As soon as the fibrous compartments of the breast rupture from great tension of the inflammatory exudation within them, the appearance characteristic of superficial abscess is present. The pain changes its character and consists of a throbbing and dull, continuous ache ; chills supervene, and the pulse becomes rapid and feeble. The patient sweats profusely and exhibits the manifestations of great prostration. The whole gland itself becomes enlarged and indurated. As the process advances the nipple becomes retracted and the skin becomes red and œdematous. A point of fluctuation soon can be felt, and incision at once relieves the patient. If the abscess is superficial, and is situated between the gland and the nipple and areola, the local signs are present, but the constitutional symptoms are wanting. The pain is less severe, owing to the fact that the inflammatory exudation is not pent up within fibrous compartments as in the intraglandular variety. In some cases there is extension of the process, so as to involve a large area of subcutaneous connective tissue, under which circumstances the local and constitutional disturbances may be severe. In these cases the skin is often entirely destroyed.

If the abscess is situated in the retromammary region, the most important sign is the forward projection of the gland from the anterior surface of the thorax and a sense of fluctuation when the gland is pushed back upon the thoracic wall. The conditions are somewhat similar to those found in acute synovitis of the knee-joint when the patella is pushed down upon the joint, and is found to be exceedingly elastic on account of the bone floating upon the fluid which has rendered the capsule tense. The constitutional symptoms may become severe, although at first they are as a rule mild. The skin over the breast eventually shows evidence of pointing, and the pus may find its way through the

gland itself or point in the axillary region or upon the sternal side, as the gland structure is here less compact and thick.

The **prophylaxis** of mammary abscess is most important. In fact, with proper management the breast ought not to be the seat of an abscess during the existence of the lacteal function. As acute mammary abscess is due in nearly every case to the entrance of bacteria into the ampullæ and ducts of the gland through the openings in the nipple, this avenue of infection should be shut off by the application of the principles of antiseptic surgery. The nipples should be thoroughly washed after each nursing, and then carefully dried, and over them sprinkled some dry powder, such as talcum or lycopodium or bismuth. The washing of the nipple after use removes the bacteria, and the drying of them prevents their multiplication, since bacteria are not likely to generate upon a dry surface. The nipples can occasionally be washed with alcohol or borax with a view to harden them and to make them more erectile and firm. In this condition an infant can better nurse, and at the same time cause little discomfort to the mother.

If the breasts show any tendency to become indurated and give evidence of pain and tenderness, they should be supported. This can be done best by placing a pad or roll of antiseptic gauze between the two mammæ, and then passing a broad roller bandage under the axilla to compress gently the breasts toward the median line. If a galactocele appears to be forming and the nipples secrete milk, the mammæ should be gently stroked by the nurse with sterilized hands from the axilla toward the nipples. The manipulation will often relieve the milk engorgement and cause the breast to assume its normal condition. If the gentle massage is followed by relief, which is manifested by absence of pain, the act should be repeated at certain intervals. If, on the other hand, the stroking is followed by increase of pain, the massage should be discontinued at once and the breasts allowed to remain without any interference. The repetition or discontinuance of the massage depends upon the result, just as passive motion in an inflamed joint is to be prohibited when the manipulation excites pain.

The **treatment** of a crack or fissure in the nipple should begin at the earliest possible moment in order to have success in the healing. The nipple should be cleansed and dried, and then the fissure painted with a strong solution of nitrate of silver. A shield should be worn until the fissure heals, in order to keep the saliva of the infant from coming in contact with the abrasion, and at the same time preventing any more than the necessary friction during the act of suckling. Breast-pumps, as a rule, are objectionable, and should not be used if they can possibly be avoided. The better plan of relieving an engorged breast is to paint it with a 2 per cent. solution of oleate of atropine made up with an alkaloid; and this answers very much better than the old and stereotyped application of belladonna plaster or ointment.

The treatment of abscess of the breast depends upon the character and cause of the abscess, and also upon the physiological condition of the breast. If the abscess occurs in the infant's breast, the pus must be evacuated as in any other form, and the principles of antiseptic surgery applied. If in the gland or in the retromammary structures, hot fomentations should be applied, with support to the breasts and fixation of the

arm. When fluctuation is present, incisions must be made in lines radiating toward the nipple, so as to avoid cutting the lactiferous ducts. The cavity should be scraped out with Volkmann's spoon and irrigated with some antiseptic solution. The cavity can be closed with deep and superficial sutures or packed for a few days with iodoform gauze. Boeckel recommends complete excision by taking out a cuneiform piece, so as to include the whole abscess-sac. He treated six cases by this method with healing by primary intention under the original dressing.

No rules can be given to be observed in all cases, but in each case the lining membrane of the abscess must be removed by one or the other method.

If a fistula follows the incision, an operation for its cure should be postponed until lactation has ceased. The fistula can then be scraped and an astringent solution be injected and compression applied. Hey suggested cutting up the sinus from beginning to end and then packing it, so that it would heal from the bottom by granulation similar to a fistula in ano. The fistula can be excised and union by primary intention secured.

The *chronic*, *cold*, or *tubercular abscess* is found in the majority of the cases in married women, although the disease is not so frequently associated with lactation as is the case in the acute variety. This abscess usually is situated in the middle of the breast, and appears in the form of a lump with a semi-elastic feel. The disease is seldom if ever found in the ante- or retromammary regions. The nipple is retracted in about 50 per cent. of the cases, and the skin is often adherent over the abscess. The pain is not present as in the acute variety. The axillary glands are occasionally enlarged. The pus contained in the abscess may contain bacilli tuberculosis. The disease progresses slowly, and weeks or even months may transpire before the abscess has attained any appreciable size. The abscess may be associated with a general induration of the gland, like tubercular abscess of the testicle.

The **treatment** of cold abscess in the breast is identical with that of cold abscess in any other locality. Free incision, scraping, irrigation with bichloride of mercury or a solution of iodoform, and closure by deep sutures is the routine procedure. Occasionally the wound is packed with iodoform gauze instead of closing it at once, and healing takes place by granulation from the bottom of the wound.

The best method of dealing with the induration is an open question. If it is sufficiently circumscribed, it should be excised, but if diffuse, the gland should be entirely removed.

ACTINOMYCOSIS OF THE MAMMARY GLAND has been observed in a few cases. The disease may affect this gland as a primary or a secondary affection. In the latter case the disease begins in the chest-wall and extends inward to the lung. A sinus is thus formed, which gives rise to the opinion that the tract is tuberculous.

Actinomycosis may first involve the lung and extend outward, and then involve secondarily the chest-wall and the mammary gland. In 4 out 59 cases the gland was involved in this way. In the former case the actinomycosis involves primarily the mammary gland itself. Müller has reported 2 such cases in which the disease began as nodules in the gland, which soon became painful, and in a short time the entire gland

was involved. In these cases the actinomycosis should be looked for in the pus or in the gland-structure after amputation of the breast.

The mode of infection is explained in one case by a superficial knife-wound of the breast.

The **treatment** is immediate amputation of the entire gland.

The examination of the female breast for the purposes of diagnosis is a matter of importance. The surgeon should be familiar with the normal palpation of the breast in order to differentiate the abnormal conditions. It is best to have the patient assume the recumbent position, as Bryant of London has suggested, so that the entire breast appears to ocular inspection. The palm of the hand should be placed over the nipple, so that the fingers and thumb radiate from that point, and in this way the whole gland can be felt. If now the breast is gently pressed back upon the chest-wall, any infiltration or induration or nodule will at once become apparent, because the limit of pressure is fixed posteriorly, and the only direction in which the growth in the gland can be felt is anteriorly toward the palm of the hand. If a lump is felt, the surgeon can now remove the palm of his hand from the breast and endeavor to grasp gently the mass in order to examine the characteristics of the tumor. The points to be considered are—the consistence of the growth, the presence of mobility, the existence of fluctuation, the enlargement of the axillary glands, the evidences of an injury or an antecedent inflammatory attack, the quadrant in which the mass is found, the fact of great tenderness on palpation, and the condition of the cervical and suprascapular glands.

The physical examination of the chest should not be omitted in the local examination of the breast, since it is very important to eliminate any metastasis in the lung or pleura or bronchial glands. At the same time, the existence of any disease of the heart can be ascertained in case it is necessary to administer an anæsthetic.

In examining the breast the surgeon should always map out the gland by imaginary lines into a quadrant. The different segments are termed superior external and superior internal, and inferior external and inferior internal. The gland can also be divided into the superior hemisphere, which embraces the superior external and internal, and the inferior hemisphere, which includes the inferior external and internal segments. It may also be divided into the external and internal hemispheres.

ATROPHY of the breasts may occur as a physiological or a pathological process. The former is observed during old age. The wasting of the glands begins at the climacteric period and continues until the end of life. The rule is not constant, since occasionally in women who have passed the menopause well-developed breasts still exist. The amount of wasting and the time at which it begins are subject to wide variation. Any inflammatory change which has impaired the nutrition of the glands is said to bring about atrophy. At the end of a period of lactation the breasts return to nearly their former state. The gland-tissue undergoes atrophy and fat becomes infiltrated in the stroma. The skin over the breast has white striæ, which differentiates it from the virgin mamma. At the end of final lactation the parenchyma begins to shrink, and the gland itself markedly diminishes in size. The ligaments of Cooper begin to disappear, and finally there is nothing left except the few ducts

leading to the nipple and a few acini. All these elements are enclosed in a stroma composed of dense fibrous tissue, and here and there a few cysts form, known as "involution cysts."

In the pathological variety of atrophy the process is independent of any physiological changes incident to the menopause. The pathological atrophy of the mammæ during the sexual life of the patient may be due to repeated lactation; to the sudden suppression of the sexual function; to the failure of suckling or to a too prolonged suckling or to the weaning of offspring at too early a date; also to the presence of syphilis, to oöphorectomy, and to diseases of the ovaries. The administration of large doses of iodide of potash has been said to cause atrophy of the breast. The writer has had occasion to administer several hundred grains of the iodide of potash to a young girl suffering from paralysis, and, though the drug was employed for many weeks, and effected a complete cure of the paralysis, there was no atrophy of the breasts. If a section be made of a breast in which the atrophic process has begun, the changes are not at first apparent, since the fatty tissue in and through the gland prevents the diminution of the size of the breast. A careful examination, however, reveals the presence of the nipple, and the ducts leading from it into the fatty tissue and the glandular structure absent.

The **treatment** of atrophy of the breast consists in stimulating the circulation in the breasts by the judicious use of the breast-pump by the surgeon, or by the employment of some apparatus to cause suction of the nipples.

Gentle massage is recommended, and it is stated by Williams that this procedure has been known to induce lactation in non-pregnant women who have borne children, and even in virgins.

The employment of massage is a means which can be only exceptionally employed, and not generally recommended, since the trouble it is intended to relieve may develop a more serious affection. The use of electricity to the spine and ovaries has been suggested, on the ground that this produces a stimulus to the mammary circulation. Relief from mental anxiety, good nutritious diet, change of air, and sea-bathing, with the administration of suitable tonics, are about all that the surgeon can advise to stimulate the growth of mammæ that have begun to undergo atrophy.

HYPERTROPHY of the breasts consists of a general hyperplasia of the entire gland. It is not an enlargement of the breast due to the presence of any tumor or to an overgrowth of any one of the many component parts of the gland, but the enlargement is due to the increase of the normal constituents of the mammary gland. The term has been used until recently in a most indiscriminate manner, but it is now understood that hypertrophy of the gland refers, as has just been mentioned, to an increase in the normal structures of the gland. The disease is rare, since Williams states that "while 2422 cases of mammary neoplasms came consecutively under treatment at Middlesex, University College, Bartholomew's, and St. Thomas's hospitals during a period of from sixteen to twenty-one years, only 6 cases of diffuse hypertrophy was seen in the same period." The disease has been known, according to Delbet, since the time of Galen, and has been described by Velpeau, Billroth, Labarraque, and others.

Hypertrophy of the breast is characterized by the absence of symptoms indicating an inflammatory condition of a circumscribed tumor. Both breasts are generally involved, and they have a smooth, homogeneous feel. The writer has seen only two cases of unilateral, but several of bilateral, hypertrophy. In tumors usually only one mamma is involved. If the disease affects the male, it is sometimes found in connection with tuberculosis of the lung and is unilateral.

Hypertrophy of the breast appears under two varieties—the physiological and the pathological hypertrophy. Physiological hypertrophy is very rare, and occurs during parturition and lactation. The tendency of the general enlargement when due to this cause is to become smaller after the gland has performed its function. This variety needs no special description, and seldom if ever requires any surgical interference.

The pathological hypertrophy may be diffuse or circumscribed. The circumscribed or partial hypertrophy involves one or more lobules of the gland, and does not involve the entire body of the gland, as in the diffuse variety. In the partial hypertrophy there is felt a firm and circumscribed enlargement of the lobule, or if several are involved the lobules are held together by loose fibro-fatty tissue. The mass is in striated nodules radiating from the centre of the gland, and generally toward the axilla in the upper and outer quadrant of the breast. These radiating elongated nodular masses do not form adhesions to the integument covering the gland or produce a retraction of the nipple, as is the case in scirrhus. Pain is absent in this slow-growing neoplasm, and a serous or mucoid discharge often exudes from the nipples.

Partial hypertrophy of the breast must be differentiated from chronic mastitis, tubercular abscess, and adenoma.

In chronic mastitis the presence of a subacute inflammation, tenderness and diffuse swelling, pain upon manipulation, and sympathetic enlargement of the axillary glands, serve to distinguish the affection. In tubercular abscess the origin of the disease in the body of the gland itself or else from the bony parts underlying the gland, the history of tuberculosis, the presence often of a fistula, the existence of a wide area of induration, the presence of a hard, nodular mass, with occasional retraction of the nipple, adhesion of the skin, and often with a purulent discharge from the nipple, with, possibly, sense of fluctuation, serve to distinguish this affection. In adenoma the absence of retraction of the nipple, the age of the patient, the presence of a circumscribed tumor freely movable under the skin, the absence of pain, serve to distinguish this variety of neoplasm.

The writer examined a museum specimen of a tumor which was removed by Mr. Silcock of London in which the growth was supposed before operation to be hypertrophy of the gland. The examination of the growth revealed the presence of a large adenoma with a distinct fibrous capsule, and had a markedly lobular appearance. The tumor measured eighteen and a half inches around the base. The girl was thirteen years of age, and the growth was enucleated without any hemorrhage. The nipple and breast were not removed.

Partial hypertrophy of the breast is recognized by the presence in the gland of multiple nodules affecting lobules, between which are formed

against, since the vessels are often very large and retract out of reach of the surgeon. The hemorrhage was controlled by the writer by transfixion of the breast with Wyeth's needles, around the centre of which strong antiseptic silk has been wound in the form of a figure of 8. By some the elastic bandage has been employed. In the cases upon which the writer operated the bandage was used in one case, and in another Wyeth's needles, and in still another no artificial mechanical means were employed, and each vessel was secured at once by forceps as the operation proceeded. Williams collected the results in 22 cases, and in only 1 did death follow, giving a mortality of 4 per cent. for the operation.

ADENOMA of the female breast is the chronic mammary tumor of Sir Astley Cooper, the tumeur fibrineuse of Velpeau, the corps fibreux of Cruveilhier, or the hypertrophie partielle of Lebert.

Adenoma, strictly speaking, is an adeno-fibroma, since fibrous tissue is interwoven with the glandular hyperplasia. In fact, the adenoma has its physiological prototype in a breast undergoing changes incident to lactation. Adenoma differs anatomically from the normal gland in an excess of connective tissue, and by a departure from the normal form and size of the glandular elements, and physiologically by the absence of the secretion of milk.

The tumor is essentially benign when it presents in this form, and takes its origin from the parts of the breast where the fibrous and glandular constituents are intermingled. It may, however, subsequently degenerate into epithelioma. This fact gives to this tumor a peculiar clinical significance. Orth believes that these tumors may originate from the adventitia of the milk-ducts or from the surrounding connective tissue in conjunction with hyperplasia of the gland-tissue. This tumor is found in healthy young women during the period from puberty to the age of thirty-five. The tumor is usually solitary and movable; it is also hard and encapsulated, and is generally about the size of a walnut. It is lobulated, so that the sensation experienced in manipulating it is similar to that obtained by handling a lipoma.

Raymond Johnson, in an analysis of 396 cases of tumors of the female breast treated consecutively in the University College Hospital, found that 65 only were pure adenomata, while Gross observed only 2 among 649 cases of neoplasms of the breast. The mixed variety, however, is often found.

The adeno-fibroma affects the left breast in a greater proportion of cases, and it is situated usually in the upper half of the periphery of the gland, though it may be found taking its origin from the centre of the gland. The adeno-fibroma grows very slowly, and after having attained a moderate size may remain quiescent for years. The tumor, may, however, under exciting causes, as pregnancy or lactation, suddenly start up and grow very rapidly until it attains a large size. In the Hunterian Museum the writer examined one which weighed three and a half pounds. The clinical history of adeno-fibroma shows that sharp pain is usually absent, although an occasional sense of uneasiness often pervades the breast, and during menstruation may even amount to a darting, lancinating pain. Mr. Birkett mentions a case in which great pain was present, owing to the inclusion of a nerve in the mass. In exceptional cases the pain has been great—at least it has been so described by the

patients. In these cases there is an hysterical element, and the writ has seen many cases of adenoma in which the pain was such as to poi to the presence of carcinoma. The hysterical element must be consider in nervous patients. The nipple is not usually retracted, although case the adeno-fibroma involves the central portion of the gland it m cause a retraction of the nipple by placing the lactiferous ducts upon t stretch, which causes the nipple to be drawn inward. The skin over t tumor and breast is unchanged unless the tumor grows very rapidly, which case the tension is so great as to cause the skin to become inflam and subsequently to slough, and thus allow the tumor to escape from environment.

The lymphatics in the axilla are not, as a rule, involved in the aden fibroma, but occasionally they are tender from a sympathetic involv ment. The mobility of the adeno-fibroma is characteristic of this pa ticular neoplasm, since sarcoma is a fixed tumor in the gland. In ca of widespread infiltration in the gland occurring in adenoma, inflamm tory disturbances or else the possibilities of carcinoma are to be co sidered.

Adeno-fibroma may occur in two varieties—the solid and the cysti the latter of which is often termed adenocele.

In the solid variety the tumor is encapsulated, and is usually fou in the superficial part of the breast, but in exceptional cases is found the centre of the organ. If the growth is in the periphery of the glan the skin is often elevated, so as to be slightly irregular. The acini the gland are imbedded in the fibrous stroma.

In the cystic variety, called also adenocele, the tumor is likewi encapsulated, and the acini which are imbedded in the stroma of fibro tissue are dilated so as to form cavities the interior of which are lin by epithelium. From the walls of these epithelial-lined cavities form by the dilated acini papillomatous growths develop. The writer h observed several of these small growths in one cyst, and in another ca several cysts in the same breast, and in the cysts there were multip small papillomatous tumors almost filling up the entire cavity.

The adenocele by its growth causes atrophy of the gland from pressure-effects. The adenocele usually occurs at a later period than t fibro-adenoma, since the majority of the cases are found after thirty a up to fifty years. The cystic variety attains a larger size than the soli and may grow so as to weigh ten or twelve pounds.

The treatment of adeno-fibroma is excision of the growth, since t tumor is likely to grow rapidly in response to some exciting cause, su as traumatism, pregnancy, or lactation. Removal is therefore advis because the growth will not disappear spontaneously, but may deger rate into a tumor of a malignant type. If the growth is small, enca sulated, and movable, and the patient young, it can be enucleated wi out removing the entire gland by pinching the tumor between the thu and fingers, so as to push it toward the periphery of the breast, and t skin thus made tense can be incised and the tumor removed with destroying the functional possibilities of the gland.

The same rule is observed in this operation as in opening absces of the breast as regards the direction of the incision, which sho radiate from the nipple and be below the level of the nipple, if practi

ble, so as to avoid a scar upon the front of the breast. Dr. T. Gaillard Thomas has suggested making an incision in the fold of the skin joining the lower segment of the gland to the thoracic wall, and then separating the base of the gland from the pectoral muscle, after which opening the gland upon its posterior surface for the purpose of removal of the tumor. In this manner the disfigurement of a scar is avoided upon the front of the breast. It is important to avoid a cicatrix, as the scar destroys the natural beauty of the female breast. In view of the fact that adeno-fibroma may become recurrent like the simple fibroma, and may be converted into a malignant neoplasm by certain changes incident to involution of the gland, it is often necessary to remove the entire gland, especially if the tumor is multiple or is large in size or the patient is over thirty-eight or forty years of age.

The recurrence of an adeno-fibroma after removal by the knife seldom occurs. The cases of a so-called return of the adeno-fibroma in a few months after the excision are not recurrences, but they are probably due to the fact that other growths were overlooked at the time of the original operation. These very small growths often develop quite rapidly in response to the stimulus of an operation upon the gland.

Very little can be expected from local remedies such as have already been described. The writer has observed a diminution in the size of the general growth, but this was not due to absorption of the tumor-mass itself, but to the absorption of the collateral induration which is often observed in these cases.

Recent pathological observations have demonstrated the possibility of a degeneration of the adenoma into epithelioma; and in consideration of this newly-acquired knowledge the writer feels justified in advising the removal of the entire gland if the patient is over thirty-five years of age, and especially if the growth is very painful and of large size. If this step is not taken, the breast should be carefully examined from time to time, and immediate removal of the gland be undertaken if any enlargement appears.

LIPOMA of the breast is very rare. In 2397 cases of tumors of the breast collected by Williams there was not a single case in which the disease developed from the fatty tissue of the gland. Lipoma of the breast must not be confounded with an increase of the fat surrounding the gland or hypertrophy of the fatty capsules. Lipoma may grow from the subcutaneous fatty tissue in the skin covering the breast, or it may even grow from the tissue behind the mammæ, but seldom, if ever, from the gland itself. If a lipoma originates in the skin, it seldom attains any appreciable size, while the lipoma which takes its origin from the retromammary tissue may assume large proportions. In this case the lipoma pushes the breast forward, and even by its constant pressure causes the gland to undergo atrophy. These retromammary lipomata weigh anywhere from one to twelve pounds. In Péan's collection is a lipoma which showed signs of ulceration, and in another case the tumor proved to be a fibro-lipoma and grew to be a very large neoplasm.

The **treatment** of lipoma of the breast varies a little according to the situation of the neoplasm. If the tumor grows from the paramammary subcutaneous fatty tissue, it can be excised without disturbing the breast.

The intramammary lipoma can also be enucleated without a sacrifice of the gland itself. In the retromammary lipoma the breast must be usually removed with the growth if there is any difficulty in controlling the hemorrhage or in providing for free drainage. The breast under these conditions has usually become so impaired by pressure of the tumor from behind that the function of the gland is lost, and there is no special advantage in leaving the gland without its complete enucleation.

Czerny has recently reported a case of chronic interstitial mastitis in which he performed an amputation of the breast, and at the same time availed himself of the opportunity of transplanting a lipoma into the wound to take the place of the excised breast. The lipoma was situated in the lumbar region. A year after the operation the patient is reported as having a well-formed breast, and the usual deformity following excision of the breast was thus obviated. Such a procedure is questionable even for cosmetic effects.

CHONDROMA AND OSTEOMA.—Chondroma and osteoma of the breast have been observed in a few cases. They are mere surgical curiosities. The tumor consists of cartilage- or bone-cells which invade the stroma of the gland. It is not so uncommon to find imbedded in sarcoma and carcinoma of the breast a nucleus of cartilage or of bone. The presence of pure chondroma or osteoma in the breast is explained by the displacement of such cells during fœtal development. These cells may remain dormant for years until some injury excites their proliferation. These tumors have been described as appearing in the mammary region and springing from the ribs and sternum.

The **treatment** consists of removal of the growth, which ordinarily has no tendency to recur.

ANGIOMA of the breast has also been observed in a few cases. The tumor consists of a congeries of blood-vessels imbedded in the subcutaneous tissue covering the mammary gland or nipple. Angioma may affect the gland itself, as has been reported by Bryant of London.

The vascular tumor may vary in size from a pin's head to a good-sized mushroom. The writer saw a specimen of very large venous angioma which involved the entire breast. It was said that the integument over the gland was of a purplish hue and pulsation was well marked.

Excision of the growth is the best **treatment**, care being observed to avoid wounding the lactiferous ducts.

There is nothing special in angioma affecting the skin over the breast, and for a full description of the treatment of angioma the reader is referred to the article on that subject.

PAPILLOMA of the female breast is extremely rare. Williams in his interesting and valuable book states that out of 2397 mammary tumors only 3 papillomata were found. In a discussion of the diseases of the nipple and the areola papilloma will be considered. Suffice it to say in this connection that a papillomatous growth may originate from the lactiferous duct and protrude at the nipple.

The **treatment** consists in excision of the growth if it can be performed without destroying the nipple; if this is not practicable, the entire breast must be removed.

SARCOMA of the female breast is not often observed. Williams found in 1081 cases of sarcoma only 99 of the breast, of which 5 were in males and 94 in females. This same observer has pointed out the fact that only a little over 3 per cent. of the tumors of the female breast are sarcomata.

Raymond Johnson collected 396 cases of tumors of the female breast which were treated consecutively at the University College Hospital, of which only 14 were sarcoma.

The writer finds 6 cases of sarcoma in an analysis of his own 116 cases of primary neoplasms of the breast, which gives in his collection a little over 5 per cent. for sarcoma in the female breast.

Sarcoma may take its origin either in the connective tissue surrounding the lactiferous ducts, in which case it is called an adeno-sarcoma, or else in the connective tissue outside of the ducts, in which case it is called a pure sarcoma. Sometimes the arrangement is such that alveolar spaces are found somewhat similar to the arrangement of carcinoma, in which case it is called an alveolar sarcoma.

Melanotic sarcoma of the breast may occasionally occur (Fig. 432).

FIG. 432.

Sarcoma of breast (*Deutsche Chirurgie*).

Mr. Bryant of London in his valuable book reports 2 cases—1 in which the melanotic sarcoma of the right breast followed the removal of a growth which had originated in a mole upon the left forearm. In the other case the melanotic sarcoma of the breast followed the excision of a melanotic tumor which originated in a mole over the sternum.

The cells of which the tumor is formed vary. Thus Gross has shown the percentage proportion as spindle-celled 68, round-celled 27, and myeloid 5.

Paulowsky described the presence of certain protozoa imbedded in the cells, and Clarke has made the same observation.

In any of the above-mentioned varieties cysts may be found, the manner of formation of which will be considered at length under the Cystic Tumors of the Breast.

The adeno-sarcoma forms the greater proportion of cases by far, and will therefore be first clinically described. The tumor begins as a solitary circumscribed hard lump in one breast. As in carcinoma, so in sarcoma, the left breast is most often affected, but in sarcoma, as contrasted with carcinoma, the central part instead of the peripheral is the more often affected. In the majority of the cases the upper segment of

the breast, and notably the upper axillary portion, is most frequently involved. In only about 2 per cent. of all the cases both breasts are involved.

As the sarcomatous nodule develops a fibrous capsule surrounds it, so that the cells with a small portion of the gland-tissue are held within a circumscribed area by a distinct capsule. In this respect the growth of the sarcoma differs from the carcinoma, which is not encapsulated, and also in another notable respect, in that fatty tissue is not found in the sarcomatous nodule, as in carcinoma. As the sarcoma continues to grow, cysts are often found within the tumor surrounded by its capsule. In these cysts within the sarcoma papillomatous growths may appear, or even loose fibroma.

If the glandular part of the adeno-sarcoma is not changed in its process of evolution, no cysts will be found, and the tumor will not attain any unusual size; but if during the development of the tumor the glandular portions are altered and the ducts or acini dilate, cysts are formed within the encapsulated mass, and these cysts may enlarge pari passu with the other parts of the tumor, so that the entire neoplasm may grow to be of enormous size.

Hemorrhages may occur in these cysts, so that they may be rapidly enlarged with fluid blood, or, again, the blood may on account of its altered condition undergo a semi-coagulation, and these clots fill up the cavities. Mr. Bryant of London mentions a case in which a quart of blood was removed by tapping. The non-cystic adeno-sarcoma is not so distinctly lobulated in appearance, is of globular form or occasionally ovoid, and varies in size from a pigeon's to a turkey's egg. The tumor has a semi-elastic but firm feel, the latter of which varies according to the excess of fibrous tissue, and the former according to the amount of cellular elements.

If an adeno-sarcoma which has just been removed is cut into, the surface has the general appearance of flesh, from which the name of "sarcoma" is derived. Horizontal or vertical clefts are observed also, and they are formed by included glandular tissue in which the remnants of the lactiferous ducts are imbedded. These ducts are often the seat of minute cysts from slight dilatation, and in these small cysts broken-down cell-débris, with occasionally a slight amount of fluid, is found. If the cut surfaces of the tumor be carefully examined, they will be seen to present a convex surface instead of the concave or cup-shaped appearance seen in carcinoma.

The sarcoma is usually rich in blood-vessels, so that the tumor may pulsate in a manner similar to an aneurysm, the differential characteristics of which have already been mentioned in connection with a study of that disease. In the round-celled variety the blood-vessels are so delicate and so numerous that they seem to form channels between the cells. The hemorrhages in the cysts, together with the cells, give rise to the so-called malignant blood-cysts.

The *cystic adeno-sarcoma* is a much larger tumor. The skin over it soon becomes congested and œdematous, and the superficial veins in the integument are clearly outlined. As the tumor grows the skin becomes tense, and a fungous growth appears which ulcerates and forms the so-called fungus hæmatodes (Fig. 433). The nipple is flattened by the

stretching of the skin over the breast, but is not usually retracted as in carcinoma.

The capsule in this variety still surrounds the mass, but in very large forms the capsule is often indistinct, on account of the stretching and pressure-effects, the latter of which causes the capsule to undergo a certain amount of atrophy. In some cases the limiting wall is lost. The cysts are filled with albuminous fluid and broken-down cell-débris, leucocytes, corpuscles of Glüge, and even granulo-fatty material. If the breast has been removed at a time when functional activity has not long

FIG. 433.

Ulcerating cysto-sarcoma of breast (*Deutsche Chirurgie*).

ceased, milk is found in the cysts. Cystic adeno-sarcoma may remain quiescent for a long time, and then, again, grow very rapidly, so that cases have been observed in which the tumor has weighed from five to twenty-five pounds, and in one case reported by Velpeau the tumor weighed forty-four pounds and measured forty-four inches in circumference and fourteen and a half inches in diameter, and nearly two quarts of fluid were removed by tapping.

The axillary glands are not usually involved, unless in the round-celled variety. The disease spreads along the arteries and veins, so that the adjacent structures may become infected. If these secondary growths exist, they are peculiar in that they contain no glandular elements. The fact must not be overlooked that sarcoma may occasionally spread by the lymphatics, so that dissemination may occur by the lymph-channels as

well as by the blood-vessels, and finally the disease may be spread by local recurrence.

The disease seldom attacks the pectoral muscle or fascia. Dissemination may occur in the viscera. Gross has shown this to be the case in 18 per cent. of 91 cases, and Schmoler found it to be the case in 12 per cent. Dissemination has not been found in the myeloid variety. Local recurrences may appear after removal by the knife, and if glandular elements are found in the nodules following a second operation, it indicates that either the entire mass was not removed at the first operation or else that a portion of the gland left behind had assumed the same malignant action. Gross states that sarcoma recurs in over 60 per cent. of the cases, and that 57 per cent. of the recurrences occur within six months, and that 28 per cent. occur after the first year, and only 8 per cent. after the second year, and that the period of immunity is longest in the myeloid variety, and next in point of frequency comes the spindle-celled, and, lastly, the round-celled; and that in the cystic variety the recurrence follows in about eight months, and in the non-cystic variety in about thirteen months.

The **diagnosis** of an adeno-sarcoma from an adeno-fibroma is in the early history of the disease almost impossible. The differential diagnosis may be made by a study of the following facts: In the adeno-fibroma the tumor affects young women, as a rule, before the thirtieth or thirty-fifth year, whereas in adeno-sarcoma it is usually subsequent to this period. In adeno-fibroma the tumor is distinctly lobulated, freely movable, slow-growing, and firm in consistence; on the other hand, the adeno-sarcoma is not so distinctly lobulated, is less freely movable owing to its intimate connection with the gland parenchyma, is more rapidly growing, and is semi-elastic, the degree depending upon the formation of cysts.

It follows that the older the patient, the less lobulated the feel of the tumor, the greater the rapidity of the growth, the more altered the appearance of the skin, the more likely it is that the neoplasm is an adeno-sarcoma.

The **differential diagnosis** between sarcoma of the breast and carcinoma consists of the following points: Sarcoma is derived from the mesoblast of the fœtus, disseminates by blood-vessels, is often encapsulated, has a late cachexia, is a tumor of middle life, is not usually painful, and is not generally accompanied by retraction of the nipple or by lymphatic or muscular or fascial involvement. Carcinoma of the breast, on the other hand, is derived from the epi-, meso-, and hypoblasts, disseminates by lymphatics, is never encapsulated, has an early cachexia, is a tumor appearing during or after the menopause, is usually very painful unless it is the colloid variety, and is generally accompanied by retraction of the nipple.

The **treatment** of sarcoma of the female breast is the same as that of carcinoma, and the technique of the operation will be presently described. While the disease is not likely to be so widespread as in carcinoma, yet it is advisable to perform a thoroughly radical operation, as clinically it is impossible to determine whether or not the growth has not broken through its capsules or adjacent structures and caused infection through the medium of the blood-vessels.

The question of repeated operations is an important one, since Gross operated in 1 case twenty-three times and removed fifty-two tumors, eleven years after which there had been no return of the disease.

The writer has performed six operations upon the same individual for the removal of sarcoma in which the primary growth took its origin from the axilla; after which the breast was removed, and then on four different occasions sarcomata were removed from the inguinal region. The patient has enjoyed an immunity for over three years, and with no manifestation at present of any return.

In sarcoma of the breast statistics are very meagre. Butlin gives no results either as to mortality or as to permanent recoveries.

Williams reports 10 cases of sarcoma of the breast in which no deaths occurred in consequence of the operation itself. The subsequent histories of only 2 out of the 10 cases are known. Death occurred in two cases within a short period from the date of the operation. The percentage of permanent cures therefore amounts to zero, since no patient recovered so as to be free from the disease for a period of three years. It is to be regretted that nothing is known of the 8 cases, since among the list there may be some cases of permanent cures. Gross reports 91 cases operated upon, with 13 per cent. of permanent cures.

The writer has had 6 cases of sarcoma of the breast in which no death occurred in consequence of the operation itself. The subsequent histories are all known: 4 of the 6 cases were permanently cured, and the remaining 2 cases died, 1 from a rapid recurrence after pregnancy, and the other from dissemination in the spinal cord. This gives 66⅔ per cent. of permanent cures. Comparing these statistics with those of cancer of the breast, it is demonstrated that the percentage of permanent cures is now greater in sarcoma of the breast than it is in cancer of the breast, unless the writer's last series of 15 cases of carcinoma be considered, the results of which are given in discussing Carcinoma of the Breast.

CARCINOMA of the female breast is, unfortunately, a most frequent occurrence. The importance of a careful study of this disease can be estimated when it is considered that there were 1387 deaths from cancer of the breast in the United States in 1880.

Dr. Billings has demonstrated by statistics that carcinoma of the breast is a disease which is slowly increasing in frequency, and that it is the cause of a larger proportion of deaths in nations which have reached the highest state of civilization. Further, the importance of an investigation of this disease becomes apparent when it is considered that it has been stated that 50 per cent. of the cases of carcinoma of the female breast die within three years, and that 33 per cent. die within two years. With the exception of the uterus, carcinoma is found in the breast more frequently than in any other part of the body, and of all neoplasms of the female breast a little over 80 per cent. are carcinoma.

Williams has stated as the result of his investigation that in England and Wales there are 10,000 women at the present time suffering from carcinoma of the breast, and the same observer has shown in a most interesting analysis of 13,824 primary neoplasms collected from four large metropolitan hospitals in London, covering a period from sixteen to twenty-one years, that 2422, or 17 per cent., of the tumors belong to the breast, and of these 25 originated in the male and the remaining

2397 in the female. In other words, 99 per cent. of all neoplasms of the breast occur in females. The left breast is the more frequent seat of the disease, although the proportion is not very large, and both breasts are affected in only about from 1 to 2 per cent. of the cases.

The situation of the cancer in the breast in the majority of the cases is in the periphery of the gland. The reason of this is probably due to the fact that the acini are found in greater numbers in the periphery than in the central part of the gland. More than half of the cases of mammary cancers are situated in the upper segment. The disease appears in the greatest frequency in the upper segment, and more especially in the upper and outer segment, than the lower, and least of all in the sternal portion of the gland.

FIG. 434.

Carcinoma of breast, showing nodules in lymphatics of axilla (Clarke).

The accompanying cut (Fig. 434), kindly furnished by Mr. Jackson Clarke, shows enlargement of the lymphatic nodules just beneath the border of the pectoralis muscle, and illustrates the rule already given that in lymphatic enlargement the pectoral gland becomes first involved before the axilla. The cut also shows an extension of the disease into the axillary lymphatic ganglia. Both the pectoral and axillary nodules are connected with the original growth by indurated lymphatic vessels.

Mr. Clarke believes that some part of every scirrhus is cystic, and that in the cysts are to be found fat-like masses the size of a pin's head.

The writer has seen an atrophic carcinoma which had been present for six years, and which only attained the size of a large hickory-nut. The growth was removed, and four years subsequently it had not returned.

Mr. Clarke believes that in certain cysts of the breast there is reached an intermediary stage in which an adenoma may grow in consequence of certain stimulus, or, if there is a predisposition to carcinoma and the patient over forty-five, a pure carcinoma may develop. This is a most important observation, since it serves to explain in glandular cysts the development of adenoma in one case and that of cancer in another.

In studying the **signs and symptoms** of carcinoma of the female breast it is important to inquire—First, into the history of heredity, since a certain proportion of the cases show a tendency in that direction. The percentage of cases due to heredity is variously estimated by different observers. Bryant gives 12 per cent. in 600 cases; Gross, 9 per cent.; Paget, 33 per cent.; Nunn, 29 per cent.; and Williams, 24 per cent. in his 136 cases.

Second, into the history of traumatism of the breast, since nearly 12 per cent. of the cases of carcinoma of the breast give a history of injury. The percentage in traumatism, like heredity, is variously estimated by different observers; thus Gross gives as the result of his experience 8 per cent.

Third, an inquiry should be instituted in reference to the presence of any distress or overwhelming sorrow or great financial loss, since such shocks predispose patients to the dangers of malignant disease by depressing the general vitality.

In regard to the **physical signs**, the one of greatest importance is the hardness of the growth. This characteristic, however, is occasionally wanting in women who have a superabundance of fat in the mammæ, or in those cases where the disease runs an unusually rapid course.

Lymphatic enlargement is also a prominent early sign of mammary cancer, although occasionally the involvement is obscured by fat. The glands of both axillæ should always be examined, since a sympathetic enlargement from pregnancy or a previous mammary abscess may explain the existence of any increase in the size of the axillary glands. The infiltration of these glands in carcinoma of the breast is explained by the fact that the epithelial cells are carried by the lymph-current through the lymph-channels to the axillary nodes, and if the clavicular, subscapular, and substernal glands can be felt, they will also be often found infected. In other words, lymphatic enlargement is the result of epithelial cells lodged in the nodes, and these foci are identical with the primary focus.

In some cases the lining membrane of the lymphatic ducts becomes infiltrated with epithelial cells, and thus the disease spreads from the central focus. Visceral infiltration may also be present, in which case it is due to the presence of epithelial cells which have been carried off by the vessels to the distant internal organs.

The presence of axillary-gland involvement is the most important sign of carcinoma in the female breast. Küster submitted to careful microscopical analysis the glands removed in 117 cases of carcinoma of the breast, and in only 2 cases out of the 117 did he fail to find unmistakable evidences of carcinomatous infiltration. Mr. Gibbes has also verified this opinion in his excellent article on the formation of secondary growths in carcinoma. He has proved that carcinomatous

infiltration is found in the axillary glands even when by other means than the microscope the infiltration cannot be recognized.

Usually the lymphatics which connect the primary focus with the secondary deposits are free from infiltration, although Broca asserts that one case in every twenty shows signs of infiltration. The lymphatic nodes first involved are those situated upon the thoracic wall upon the inner side of the axilla, just beneath the border of the pectoralis major muscle. If the lymphatic nodes become large, they obstruct the venous return, and in consequence œdema occurs in the arm.

The presence of any secondary bone affection is a very strong evidence of the presence of carcinoma of the breast, since it is not uncommon to find the femur infiltrated with carcinoma in connection with mammary cancer, in which case fracture of the bone is a sequence. The writer has seen two cases of fracture of the femur occurring in mammary cancer after removal of the breast—one a year after the operation, and the other five years. The cortex is pressed upon by the growth, and the bone in consequence becomes very thin, and a fracture occurs without any special violence.

In the first case mentioned the patient sustained her fracture by simply turning over in bed. The dissemination of cancer into the bones, notably the femur and the humerus, also the ribs and sternum and vertebræ, occurs as a late phenomenon, and is usually accompanied by rheumatic pains. The cortex of the affected bones is thin, the medullary canal is enlarged, and the inorganic salts are greatly diminished. The Haversian spaces are also enlarged and contain fat. Pathological fracture of the bones may occur in sarcoma, but in this variety of malignant disease the tumor usually primarily affects the bone.

Retraction of the nipple may or may not be present. In the olden descriptions of cancer of the breast much emphasis was placed upon the fact that the nipple was drawn inward. Gross states that it is present in a little over 50 per cent. of the cases. Further pathological investigations have shown the fallacy of relying too much upon this local phenomenon as a sign of carcinoma of the breast (Plate XVI.).

The situation of the cancerous nodule influences the amount of retraction. It tends to draw the nipple out of its normal relations, and to cause it to point in the direction of the growth itself. Gross also states that about 5 per cent. of the cases of retraction of the nipple are found in connection with innocent tumors. Too much importance must not be placed upon this generally accepted sign. The writer has lately seen two so-called tumors of the breast in each of which a simple cyst in the centre of the gland caused marked involution of the nipple; also, he has observed the same condition arise in consequence of an attack of acute mastitis, especially in those cases in which suppuration followed the inflammatory attack. Retraction of the nipple may result from an injury received in early life, or in adult life it may be drawn inward by the action of longitudinal organic muscular fibres. It is observed occasionally, as has already been mentioned, in connection with chronic and tuberculous and syphilitic mastitis, as well as in abscess, more especially when the induration is situated in the central part of the gland.

Dimpling is another sign of importance, and is brought out by moving the skin over the growth in the early stages, and is a con-

PLATE XVI.

Scirrhus of Breast, showing Glands of Fat Interspersed Throughout the Cancerous Mass; also Showing Retraction of Nipple. (Richardson.)

dition which precedes puckering. The skin is very soon more or less depressed, and this condition is caused by the contraction of the suspensory ligaments of Sir Astley Cooper. The amount of dimpling is influenced by the extent of the cancerous infiltration of the lobes. Besides retraction of nipple and dimpling and puckering of the skin, infiltration of the skin is shown, and also ulceration.

The *puckering* of the integument over the gland is a valuable sign, and occurs early in a scirrhus which takes its origin from the periphery of the gland, and later when the tumor has a central origin. The puckering is caused by a contraction of the suspensory ligaments of Sir Astley Cooper, and occurs at the time when the skin becomes adherent to the gland. The puckering thus is a permanent retraction similar to that of the nipple. In the encephaloid variety of cancer the puckering is usually absent. The puckering is caused by the spread of the disease from one lobe to another, or from one lobe to the tissues surrounding the gland and beneath the skin.

The presence of *immobility*, which indicates adhesion to the pectoral muscle, is a sign of great value, although it appears rather late in the history of the disease. The same may be said also of *infiltration* of epithelial cells in the skin.

Discharge from the nipple is present as a sign of carcinoma, according to Gross, in about 7 per cent. of the cases. It is a valuable early sign, indicating cancer of the female breast in a woman who has passed her fortieth year. The amount is very slight, and consists of only a few drops of albuminous-looking fluid which is occasionally tinged with blood. It must be remembered also that cystic disease of the breast and certain solid tumors often give rise to the same phenomenon. The fact also must not be overlooked that a discharge from the nipple may be caused by catamenial irregularities and by certain diseases of the organs of generation. A chemical analysis, also a microscopical examination of the discharge from the nipple, should be made in order to ascertain if possible its character.

Pain is usually present in carcinoma of the breast. It is wanting only in exceptional cases. Its absence, however, in no sense can eliminate the existence of the disease. It is not so likely to be an early symptom in carcinoma as it is in the inflammatory affections of the gland or in some benign tumors. When the carcinoma has attained an appreciable size the pain is described by the patient as throbbing, darting, and lancinating. The pain is not constant, but intermittent, and may shoot up into the axilla or down the arm or be felt under the clavicle, and even behind upon the scapula, thus radiating according to the distribution of the nerve-filaments already described.

The existence of visibly enlarged and dilated superficial veins over the gland is usually present as a sign of carcinoma as well as sarcoma, especially in the later stages of the disease.

Cachexia in mammary cancer is sure to become established. It is a symptom, however, which occurs late in the history of the disease. The skin becomes pale, the appetite is lost, the patient is weak, sleep is disordered, and finally death ensues from asthenia, the result of general toxæmia.

Leucocytosis is a symptom of mammary cancer. Some interesting

changes are found by an examination of the blood. The number of the red blood-corpuscles is diminished, and that of the white corpuscles is nearly doubled, while the hæmoglobin is diminished about four-fifths of the normal amount. This is not the case in sarcoma of the breast or in any of the benign growths of the breast.

Freund in an interesting article on diagnosis of carcinoma of the breast has shown that there is an excess of sugar in the blood.

If a carcinoma which has just been removed be cut into by the pathologist, certain characteristic features are usually present. The mass is crisp and becomes concave upon section, showing streaks or bands of whitish color, and studded here and there with yellow spots which are fatty islands. The concave surface is caused by shrinking of the stroma following its invasion. If the concave mass be scraped with a knife, there will be found upon the blade a succulent fluid which is known as cancer-juice. This fluid is composed of epithelium which is scraped off from the alveoli, which in carcinoma are filled with epithelial cells.

The *recurrence* of carcinoma of the female breast after the removal of the gland is a subject fraught with great interest.

Williams has collected from Gross 496 cases, to which he added 47 cases of his own, and showed that recurrence took place in 83 per cent. of the cases in the mammary region, and in the axillary in about 15 per cent. Gross has shown that dissemination occurred in 17 per cent. in a series of 1036 cases. Williams has also shown that the recurrence in 60 per cent. of the cases occurred within the first six months, and of these 40 per cent. occurred within the first three months.

Secondary recurrences may also occur, and even third and fourth recurrences are observed. The writer has now under observation a patient in whom nearly a dozen recurrences have taken place, but who is at present free from the disease. In this patient more than one hundred and fifty distinct carcinomatous nodules have been removed from time to time.

The *recurrence of carcinoma* of the breast is influenced by the period of time from the appearance of the growth to the date of the operation. After a thorough search into the literature of the subject to ascertain to what extent the duration of the disease before operation influenced the question of recurrence, statistics furnish no accurate data upon this point. In a study of my own cases bearing upon this subject it was found that in all the cases in which a permanent cure for three years or more was accomplished the tumors were removed on an average of six months from the date of their first recognition in the breast. It is also an interesting clinical fact that in many of the cases of permanent cure the axillary glands were not indurated, or at least there was no outward evidence of an invasion.

In all probability, within six months from the date of the first appearance of the induration in the breast the axillary glands are not infected. That it is possible for the glands to become infected within this period of time is well established. In other words, the earlier the disease can be detected and operated upon the better the prognosis as regards any recurrence, and in a large number of the cases the disease can be diagnosticated at a time before glandular infection has taken

place; and if the tumor can be removed within six months from its incipiency and the axillary glands and fatty tissue be dissected out, and likewise the pectoral fascia and the perimammary fat and paramammary areolar tissue, the prognosis will yield brilliant results.

Great stress, therefore, should be placed upon the early recognition of the disease, and likewise upon the complete removal of the tumor, for the results show that recurrence can be usually prevented by carrying out these rules.

The recurrence of carcinoma of the breast is influenced, again, by the extent to which infiltration has taken place by any one or all of the three well-recognized ways of dissemination. When the tumor has existed long enough to show evidence of glandular enlargement or integumentary infiltration or metastatic deposit, the disease has been present for some time. If the breast and its adjacent structures are removed with the axillary glands and fatty tissue in the axilla, there is still a prospect of success; but if metastatic deposits have occurred in the distant visceral organs, there is no hope for recovery.

In regard to the first two ways of infection: if the area is circumscribed, the radical operation may be successful if all the glands and integuments are removed, but if the case has become infected by the third way of dissemination, there is no opportunity offered by any surgical operation to save the patient. The question, then, is, if the infection has occurred within specific limitations by the first and second ways of dissemination—*i. e.* by lymphatic infiltration—and by contiguous dissemination there is a prospect of cure offered by a radical operation. If, on the other hand, the infection has spread by the third way, which is by visceral metastasis, there is no hope for a cure. It is a clinical fact worthy of attention that of the cases in which secondary infection from the breast has occurred, nearly 90 per cent. of them invade the axilla, or, in other words, the disease has disseminated in nearly every case by a way that is amenable to treatment by surgical operation if taken in time. It is also a clinical fact of a startling character that in cases where metastases have occurred nearly 50 per cent. involve the lung or pleura, and it can be demonstrated that in the majority of cases the axillary involvement antedates the lung-and-pleura infection by several months; which points logically to an important fact, that excision of the axillary glands is an *imperative* step in the operative technique with a view to avoid recurrence of the growth after removal.

It may be necessary to make an extensive dissection. In one of the writer's cases the pectoral muscle was removed, and then the glands surrounding the axillary and subclavian vessels. In this case permission was given to remove the arm at the shoulder-joint if necessary to make the operation complete. Dissemination was by the first and second ways, and no recurrence ever followed this dangerous operation. Seven years later, however, metastasis occurred in the brain. Here complete operation prevented the further spread of the disease by the first and second ways of infection, but it did not prevent a metastasis, which is the third way of dissemination. In this case, with so long a period of immunity, it is possible that the pulmonary growth might have been primary, and occurring independently at this late date. Surgical interference can prevent recurrence, because in 90 per cent. of the cases the

return of the disease can be combated, or even prevented, by removal of the axillary glands muscle and fatty tissue, in addition to the complete removal of the breast.

The recurrence of carcinoma of the breast is influenced also by the radical character of the operation itself.

No procrustean rule can be laid down in regard to the extent or character of the operation for the removal of carcinoma of the breast which would meet the exigencies in every case. A radical operation in one case would be an unjustifiable one in another case. For example, in one patient upon whom the writer operated it was necessary, besides removing the breast and all its subjacent tissue, and the axillary glands and fat, the pectoral fascia and the pectoral muscle, to also excise the ribs, the removal of which exposed to view the pleural cavity. The ribs were involved in the carcinomatous infiltration, and were thin and eroded through the malignant ulcerative process. It is very unusual to find the ribs involved and to excise them during an operation.

The radical character of this operation would be no index to guide the surgeon in another case, and consequently a radical operation must be performed with certain limitations suited to the special case. There is, however, a standard operation which is none too severe to meet the necessary conditions in every case. The uniform classical operation should include the entire breast-gland, all the fatty areolar connective tissue in the vicinity, the integument over the circumscribed area of the tumor, and as much more as is necessary, leaving out of consideration altogether the question of flaps to cover the wound; and finally the pectoral fascia with the muscle.

Dr. Halsted has demonstrated that the pectoral fascia is involved in many cases of carcinoma of the breast, although to the naked eye or to the sense of the touch this infiltration may not be apparent. The writer has been able to verify this opinion in several cases, but is aware that surgeons will dissent from this severe method of operating, on the ground that they can refer to cases where a less serious operation has been performed and no return of the disease followed.

In the radical operation the death-rate is reported over three times as great where the complete operation is performed, in contrast to the incomplete; but these figures include cases of preantiseptic surgery, and are therefore misleading.

In my cases of carcinoma of the breast, if the case of hæmophilia is excluded, there was no death due to the operation. These operations were, as a rule, radical in the sense in which the term is used, and instead of 7 per cent. or 14 per cent. or 23 per cent., there has not been a death due to the operation. With every convenience at hand for performing the radical operation, and with antiseptic precautions, the operation is perfectly safe beyond the ordinary risks which attend the most trivial operation in which an anæsthetic is employed.

No patient should die from ordinary hemorrhage or from septicæmia, or from any of the remote causes due to the operation.

The direct influence upon the recurrence of the tumor of the character of the operation is illustrated by the fact that 27 per cent. more of the cases of recurrence followed the incomplete operation as contrasted with the complete.

The question of mortality of the operation itself is one of importance, for it is obviously of no avail to remove completely a carcinoma of the breast, and enucleate the axillary glands, and tear out the axillary loose fatty tissue, if the patient's life is to be sacrificed in the performance of the operation itself. After a careful study of the published mortality of the operation the writer is convinced that it is the result of this investigation that has made surgeons too conservative. To be sure, the death-rate of the operation is very high, and it is difficult to account for this excessive mortality. For example, a reference to the published reports made by surgeons reveals the fact that the mortality of amputation of the breast, including both the complete and incomplete operations, was in Gross's cases about 10 per cent.; in Oldekop's cases, 9 per cent.; in Sir Joseph Lister's cases, reported by Mr. Watson Cheyne, about 8 per cent.; in Butlin's cases, 7 per cent.; in Prof. Billroth's clinic, about 23 per cent.; in Prof. Fischer's clinic, 20 per cent.; in Prof. Esmarch's clinic, about 10 per cent.; in Prof. Küster's clinic, about 14 per cent. In another list of operations, published by Billroth, the mortality is about 15 per cent. In a still later list of 68 cases performed by Billroth there is a death-rate of about 6 per cent. In the writer's cases of amputation of the breast the death-rate was 1.47 per cent. If the one case of death which was due to continuous bleeding in a patient suffering from hæmophilia be excluded, as it can be with propriety, there is no mortality whatever connected with the operation in the writer's series of 71 cases of amputation of the breast.

Before finishing this most important part of our subject a strong protest should be made against Mr. Butlin's views in regard to partial amputations of the breast in cases of carcinoma of the gland. While the writer has been deeply and profoundly impressed with a study of his book on malignant disease, he cannot indorse Butlin's opinions in regard to incomplete operations upon the breast for carcinoma. It is advised in every case, with no exception, to remove the entire breast with the pectoral fascia and the lymphatic glands as the minimum operation in the most insignificant scirrhus.

The operation in nearly all cases must extend beyond the limits of the breast and include a most radical one. In support of this view it may be mentioned as a matter of clinical evidence that the recurrences of the disease in the writer's cases are much less frequent (1.47 per cent.), when a sufficiently radical operation has been performed.

The last reason to strengthen the argument that the operations should be more radical in order to prevent recurrences is the report of Küster, who submitted to careful microscopical analysis the glands removed in 117 cases of carcinoma of the breast, and in only 2 cases out of the 117 did he fail to find unmistakable evidence of carcinomatous infiltration. No sounder argument could be advanced than one based upon this report; and it is thus evident that not only the breast must be removed, but also the axillary glands, in order to minimize the dangers of recurrence of the disease. Mr. Gibbes has also verified this opinion in his excellent article on the formation of secondary growths in carcinoma. He proved that carcinomatous infiltration is found in the axillary glands even when by other means the infiltration cannot be recognized.

The radical operation removes cancerous cells that form the foci for

recurrences. These cancer-cells may be found outside the limits of the breast-gland, lodged in the adjacent mammary region, whence they have been carried by the lymphatic current. Cancerous masses upon and in and under the pectoral fascia, as well as in the neighboring muscles, have been found. These masses were examined microscopically and found to contain cancer-cells. Mere removal of the breast is inadequate to reach the entire disease. In order to secure immunity from the disease in every case it is necessary to adopt a radical operation as routine treatment in all cases. Heidenhain has pointed out the fact that the ligaments of the breast are often surrounded by projections of the parenchyma of the gland and contain cancer-cells. This is true in regard to the so-named ligaments of Sir Astley Cooper, as well as those which are retromammary and which bind the breast to the fascia. Cancer-cells have been found in the pectoral muscle, the adhesion of which to the posterior surface of the gland indicates the certain presence of cancerous emboli in lymphatics of that muscle. In 18 cases Heidenhain examined the pectoral fascia and retromammary fat. Of the 9 cases in which cancerous cells were found by the microscope in the deep surface of the parts removed by operation, in 6 rapid recurrence occurred. Heidenhain concludes that in two-thirds of the cases of breast-cancer microscopic deposit of epithelial cells can be found in the lymphatics which pass from the posterior surface of the gland to the pectoral fascia. These facts show the importance of the removal of the pectoral fascia and a thin layer of the muscle.

Gross was entirely right when he urged the complete removal of the breast and axillary glands as a *sine quâ non* to prevent recurrence. Mr. John Chiene even goes further than this, and takes a flap from the arm to cover the wound.

The recurrence of carcinoma of the breast is influenced still, again, by the histological character of the carcinoma itself. This cause I believe to be most important in regard to the question of recurrence of the disease. The research into this subject has involved much labor, but the result has been most satisfactory in establishing some fixed laws regarding the return of carcinoma of the breast after excision.

In order to clearly comprehend the important questions bearing upon the recurrence of carcinoma of the breast after operation, it seems also to be pertinent to review some points in regard to the origin of tumors, among which may be conspicuously classed carcinoma. It makes no difference whether the theory of the origin of tumors as propounded by Cohnheim is accepted—namely, that tumors develop by embryonic remains, and that the neoplasm is the result of an excess of cells in the growing embryo—or whether the older theories of tumor-genesis are adopted. Certain histological facts in the formation of every simple or compound tissue-tumor must of necessity confront the surgeon.

Tumors and normal growths have a common origin in the cells of the tissues and a common development in cell-segmentation. Certain characteristics distinguish tumors from ordinary growths, and these marked features of tumor-growths include their want of harmony in the economy, their absence of function, their lack of purpose, their total destruction of the organism in which they are found, and their failure of subordination to natural laws of growth. The reception accorded by the

economy to a tumor is one altogether different from that accorded to inflammatory tissue. The tumor is considered as an independent entity, stealing its nutriment from the animal economy and maintaining itself from the organism by the intervention of lymph and vascular systems, and having no nervous connection with the organism.

A tumor must be recognized as an outgrowth of the tissue-cells which are found in the body and an increase by fission and cleavage of the protoplasm of the cells. Dr. Dunham of the Carnegie Laboratory has prepared some slides showing most beautifully the segmentation process in a fresh specimen of epithelioma recently taken from a patient now suffering from this disease.

If, then, a tumor is considered as a growth derived from the same origin as repair-tissue, but with no proper function or purpose, it follows that the cells of tumors must have a wide difference, just as the cells of normal growth differ. It is this difference in the cell itself that marks the distinction between malignant and benign tumors. There are likewise differences between the cells of malignant tumors; and if it can be demonstrated that the clinical history of any case of carcinoma coincides with the special variety of cells, the recurrence of carcinoma of the breast after excision can be predicted with a tolerable degree of accuracy.

This cause of recurrence of carcinoma of the breast has received little, if any, attention by surgical writers. There has always been a general impression that the atrophic scirrhus, for example, was less malignant than the medullary carcinoma. The reasons for arriving at this conclusion have never been investigated from a purely histological and clinical point of view. An attempt will be made to demonstrate by a complete microscopical examination of the writer's cases, taken in connection with the clinical history extending over a period of three years, that the histological character of the tumor itself influences more than any other cause the recurrence of carcinoma of the breast. A reliable prognosis can be made from an examination of the nature of the histological elements which form the neoplasm. The writer has carefully prepared the clinical histories in certain cases, and then submitted each tumor for a complete microscopical examination. The result is, that the tumors which show structures departing but slightly from the normal correspond in every case with the group of cases the clinical histories of which are favorable, because no return of the carcinoma has occurred in any case belonging to that group. The tumors that showed a great departure from the normal structure correspond to the unfavorable clinical histories. In other words, the microscopic report of the tumors corresponded precisely to the clinical histories. The more typical the structure, the better the prognosis; the more atypical the structure, the more unfavorable the prognosis. Arranging all the cases in four groups, and comparing the microscopical examination with the clinical histories, the recurrence and the non-recurrence of the disease in each case correspond exactly. The plan of the arrangement of the groups will be explained in discussing this question from another point of view.

The result of the histological examination when compared with the clinical histories in this series of cases demonstrates that the more embryonic the structure of the tumor the greater the liability of recurrence. There seems to be a marked distinction, based upon the variety of the

epithelial cells. An epithelioma derived from epithelium situated upon surfaces for mechanical protection, such as the skin, mucous membrane, etc., is less likely to recur than where the epithelioma takes its origin from the epithelium situated in the secreting glands, such as are found in the rectum, or from the epithelium which forms the true parenchymatous structure of a gland, such as the mammary gland. The history of epithelioma of the lip as compared with epithelioma of the breast forcibly illustrates this law. The reason is very apparent, as Mr. Gibbes has demonstrated when he shows by microscopical examination that the carcinomatous cells lie in contact with the stroma. It is inferred that by amœboid movement these cells pass into the interfascicular lymph-spaces, from whence the lymphatic capillaries carry the cells into the nearest lymphatic node. This explains the frequency of recurrence of carcinoma in the pectoral and axillary glands and the metastases later on in the lungs and pleura. That recurrence takes place first in the neighboring glands is shown by the fact that in 128 autopsies of patients dying from carcinoma of the breast, 90 per cent. of the cases had return of the disease in the axilla, and of the entire number 45 per cent. involved the lung and pleura, and nearly 43 per cent. involved the liver. Primary carcinoma of the axilla, of the lung, of the pleura, or of the liver is so rare that it may be considered among the surgical curiosities, whereas secondary carcinoma is extremely common. Thus it is evident, to review the points under this special cause of recurrence, that epithelioma develops by asexual cell-proliferation, and that the more embryonic the cell is the more malignant the growth, and that the nearer the cell comes to the normal the less malignant the growth. It further follows that there is a marked difference between cells in repair-tissue, that there is also a great difference in cells in tumor-growths, and that a prognosis of the malignancy of a tumor can be made by an examination of the character of the cells. The clinical histories corresponded with the histological examinations, and this cause of recurrence, due to the special development of the cells, has been proved beyond a doubt, not by general statement, but by directly comparing in each case the precise clinical history with the histological examination. We are thus enabled to demonstrate that recurrence of carcinoma of the breast actually corresponds to the character of the cells which form the carcinoma, and that this proof rests upon a thorough investigation of the patients whose clinical histories have been accurately kept for many years, and taken in connection with the microscopical examination of the tumors.

The recurrence of carcinoma of the breast is influenced, moreover, by the appearance simultaneously of carcinoma in both breasts. Fortunately, this condition only exists in from 1 to 5 per cent. of the total number. In two cases which have come under the writer's observation of double carcinoma of the mammæ, one has died within a year after removal of both breasts, and the second patient is still alive and well. It is now over five years since the removal of both the mammary glands.

The appearance of double carcinoma makes the prospect of recurrence greater, owing to the more extensive infiltration. In double carcinoma of the breast the secondary deposits are most likely to occur. These infiltrations and metastases are found very early in the history of the case.

The recurrence of carcinoma of the breast is influenced, finally, by the personal factors of the individual, such as age, sex, marriage, fecundity, sterility, traumatism, heredity, menstruation, metastasis, mental condition, locality, race, and nativity.

In order to draw any conclusions from the personal factors as to recurrence of carcinoma after removal, it must be assumed that any laws which operate to develop carcinoma primarily have not entirely lost their influence in bringing about a recurrence. The capability is not always removed with the local infection. This view is in perfect harmony with the constitutional theory of carcinoma, and can be easily reconciled to the theory of local origin of cancer.

That carcinoma may be present in the body in more than one place at the same time, and that a common cause independent of autoinfection underlies the malady, have been proven in many cases.

Age has an indirect influence upon recurrence or metastasis, since it has a marked effect upon the primary growth. Gross has pointed out the fact that 82 per cent. of the cases of primary carcinoma of the breast develop after the fortieth year, and that the average is the forty-eighth year. Carcinoma of the breast is seldom, if ever, present in early life, although carcinoma in general has been frequently observed before the fifth year. In an analysis of 194 cases only 3 cases appeared after the seventy-first year, and only 1 after the seventy-sixth year. The tendency to the development of carcinoma of the breast is declining after sixty years; the conditions are also unfavorable for recurrences or metastases. In the writer's list of cases permanently cured all are under fifty years, except one, and, notably, in all the cases in which there was a return followed by death the patients were over fifty years of age. In other words, there seems to be less malignancy in carcinoma affecting the breast in the early stages of obsolescence of the gland than when the gland has fully completed its degenerative changes. Age, therefore, has marked influence in regard to recurrence, for the older the patient is, within certain limitations, the more malignant the carcinoma appears. The nearer the gland is to the healthy functional activity the less likely it is to assume malignancy.

Sex has an indirect influence upon the recurrence of carcinoma of the breast, since the disease exists in the male in the proportion of 1 to every 100 cases in the female. In the writer's list there was only one case in the male sex.

Metastases occur in over 6 per cent. of the cases of breast carcinoma in those organs in the female that are absent in the male, and metastases are seldom if ever found in the corresponding organs in the male. The writer has notes of six additional cases of carcinoma of the breast in the male besides the one already mentioned. These cases were treated by the late Dr. James R. Wood, and in no case belonging to his list did recurrence occur, as far as he has been able to ascertain.

Marriage without doubt has a direct influence upon primary carcinoma of the breast, since 80 per cent. of the cases are found among married women. This would leave 20 per cent. to represent the unmarried class. The same law, therefore, which operates to cause carcinoma in one breast incident to marriage will not altogether lose its force in causing a further extension of the disease in the opposite breast, or by dissemination by

the first way of infection in the cicatricial tissue. In the author's list of permanent cures all the patients except one were married.

Fecundity seems to affect the frequency of carcinoma of the breast. Mr. Thomas Bryant, in his excellent book upon *Carcinoma of the Breast*, has pointed out the interesting clinical fact that 74 per cent. of the women were prolific, while only 26 per cent. were sterile. To quote from his book, Mr. Bryant states that "a large proportion of the prolific women were so to an extreme degree, ten or more children to one mother being a common note to find recorded."

In the writer's list all the married patients had children, except one. In other words, there was only one patient who was married and who was sterile. These patients, however, were not prolific to an extreme degree, as in Mr. Bryant's cases. The average was three children, instead of ten or more, as in Mr. Bryant's cases.

Traumatism has a direct influence on the development of carcinoma of the breast in about 13 per cent. of the cases, according to some writers. In the male traumatism has been assigned as the cause in nearly 50 per cent. If friction, irritation, and mechanical stretching of the scar after removal of the breast can be classed under the head of traumatism, a very large proportion of the cases of recurrence are due to this cause, the prevention of which is possible in many cases.

If wearing unsuitable corsets can in any way be assigned as a cause to develop carcinoma in a woman in whom a predisposition exists, certainly this would be a most potent factor in the etiology of recurrence. A soft pad should always be worn in contact with cicatricial tissue following excision of the breast, in order to obviate one of the causes of the recurrence of carcinoma.

Thus it is evident that if traumatism will act as an exciting cause to develop carcinoma in the breast, it will operate in the same way, under given conditions, to cause recurrence or metastases in a patient favorably predisposed.

The recurrence of the disease in the scar can be largely prevented by the exercise of care in instructing the patient how to treat the tissues thus formed after the removal of the breast. Some idea of the importance of mechanically protecting the scar after removal of the breast can be formed by the knowledge of the clinical fact that a study of the cases of recurrence of carcinoma of the breast shows it to occur in "nearly every instance"—according to Butlin—"under or close to the scar." Von Winiwarter has also demonstrated that in Billroth's cases the recurrences originated in the scar-tissues. This idea impressed the late renowned Langenbeck to such an extent that the writer remembers his having suggested in his clinic the dressing of the wound with the patient's arm placed at right angles to the trunk, in order that the scar-tissue might form without contraction. In this way the subsequent moving of the arm might not cause stretching of the cicatricial tissue, and thus give rise to a continual irritation in a variety of tissue so prone to be the starting-point of recurrent carcinoma. In point of fact, the cicatricial tissue usually forms the new focus that appears after removal of the breast.

It is good surgery to dissect away the scar when it is found to be inflamed or when it seems to be irritated by stretching. This is a prac-

tice that should be adopted in all cases where the scar is irritated, even years after the original removal of the breast. This procedure will certainly remove a potent cause of recurrence of carcinoma after excision of the breast.

On the other hand, Williams has endeavored to show by a most laborious research that trauma is not the cause of cancer of the breast. He shows that men are three times more liable to traumatism than women, and yet they suffer from cancer of the breast in the proportion of 1 to 116 females. He further believes that if traumatism was the cause the nipple and areola would be the seat of cancer, whereas they are the seat of the disease in only about 1 per cent. of the cases of mammary cancer, and that carcinoma would not be solitary.

The writer believes, from a careful study of his own cases, that while traumatism itself is not a cause of cancer *per se*, yet in those women who from some reason have a predisposition to the disease an injury may excite the cell-growth, while in another person with no such predisposition a trauma will have no influence in the development of mammary cancer.

Mastitis accounts for nearly 30 per cent. of cases of carcinoma of the gland. If this irritation is sufficient to develop the disease in the breast of a patient in whom a predisposition exists, a comparable irritation, like a low grade of inflammation in young connective tissue, certainly would have a corresponding influence.

In one patient upon whom the writer operated for carcinoma of the breast traumatism in the form of a fall upon the breast, where the patient struck upon the edge of the bed, developed a carcinoma in one gland, while the other breast, which had been previously the seat of mastitis leading to abscess-formation, escaped. In other words, in this case traumatism seemed to have been a more potent factor in causing carcinoma in the breast than mastitis, for the breast exposed to traumatism developed carcinoma, while the breast which was the former seat of an abscess has shown no tendency to give rise to the disease, although the evidences of an old abscess are still apparent in the remaining breast.

In the writer's list of cases studied with reference to this point mastitis is quite common, but it is also found that in the most malignant group traumatism stands out as a most prominent etiological factor—more so than mastitis.

Heredity also may be assigned as a factor in developing secondary growth in 12 per cent. of the cases. A study of the cases of carcinoma of the breast will demonstrate the fact that a large number of recurrences and metastases will be found in those cases of carcinoma in which hereditary influence is present.

The celebrated case of Broca, which has been so often quoted, is pertinent, since out of the 26 descendants of Madam Z——who arrived at the thirtieth year, there were 15 who died of carcinoma, "whereas the cancer-mortality for the same number of persons of the general population at the corresponding period of life is considerably less than 1" (Williams). Cancer-heredity does not mean that the disease itself is transmitted, but the conditions favorable to the production of the disease or a predisposition or tendency to develop the disease.

Metastasis has a marked influence, because its presence shows that the disease has been extensively disseminated throughout the system, and therefore recurrences are most likely to ensue after the removal of the primary growth.

The *mental condition* has also an influence upon recurrence, because an anxious, nervous, restless, and irritable frame of mind predisposes by loss of sleep, imperfect digestion, etc. to depreciate the normal condition of health, and thus devitalize the tissues, which renders the soil favorable for recurrence of malignant growths in the same manner that it predisposes toward the development of the primary growth.

The *geography of the country* has a marked influence upon the recurrence of carcinoma after its removal. Carcinoma is prevalent in the New England States and on the southern Pacific Coast, in the central part of Michigan and the southern part of Wisconsin. Dr. Billings has pointed out the interesting fact that in "any given locality a large proportion of cancer indicates that the locality is healthy and a long-settled one, and has a large proportion of inhabitants of an advanced age."

In the writer's list of permanent cures the majority of patients with carcinoma of the breast lived in and about New York, or at least within a radius of fifty miles of the city. This fact, however, is best explained by local circumstances, since in the northern part of New York State carcinoma seems to be most prevalent. There were a few from New England and the Middle West.

Race has a marked effect upon the development of carcinoma of the breast, and hence the law operates in regard to the recurrence, or metastases, or multiplicity of growths. There is a marked difference between the white and colored race as regards carcinoma. For example, among the whites the proportion of deaths from carcinoma per 100,000 is about 20 per cent., and for the colored race about 5 per cent. In the writer's list there were only two cases of carcinoma in the female breast among the negro race.

It is a disease rarely found among the Indians or the uncivilized inhabitants of the islands of the Pacific.

Nativity seems also to influence the development of carcinoma, and also the recurrence. The Germans are more liable to carcinoma than the Irish, and the Irish more than the native whites. The idea can be expressed more tersely by saying that carcinoma is found more than twice as frequently among the foreign-born population as it is among the native-born of the United States.

The classification of mammary cancer is discussed in connection with the histology of the disease. A classification based upon clinical facts is of little value. All cases of cancer of the breast from a clinical point of view are serious in the extreme. It occasionally happens that carcinoma of the breast runs a very acute course. The disease may destroy life in from six to twelve months. This type usually affects the mammary integument, and the term *en cuirasse* is applied if there is a diffuse infiltration, or *en plaques* if there are irregular disks in the skin, or *acute milliary carcinosis* if small tubercles infect the skin. The presence of these nodes in the skin are the result of a secondary infection from a rapidly-growing acinous cancer, and not a primary infection, as was originally supposed. This variety may affect the skin over both

breasts, and the integument is red, œdematous, adherent, and tense. The superficial veins are prominent, and the slight elevation of temperature which occurs has given rise to the term "cancerous fever." The disease, according to Gross, is observed once in every 22 cases, and in the writer's experience once in about every 50 cases.

In marked contrast to the rapidly acute variety just described is a form which is called atrophic cancer. In this variety the progress of the disease appears to be arrested, and a gradual shrinking of the entire gland occurs somewhat after the manner in which diminution in the size of the liver takes place in the second stage of cirrhosis. This variety of cancer of the breast begins by an ill-defined hardness produced by an excess of fibrous stroma with a scarcity of epithelial cells. The cells may become obliterated by mechanical pressure, and only stroma exist. The cancer may cause ulceration of the skin, and cicatrization occurs. The atrophic variety may last for many years, and only in exceptional cases is the course acute in this variety.

The *scirrhous* variety is distinguished by the presence of a large amount of stroma and few cells. This is the most frequent variety, and usually grows rapidly—has local and regionary recurrences and internal metastases. The disease usually affects the acini, and the term acinous cancer has been applied in contradistinction to the other and rare variety known as the duct cancer. A peculiarity of the scirrhous cancer is the presence of islands of fat throughout the breast mixed with a cancerous mass. This is especially observed at the periphery of the gland.

The *duct* carcinoma of the breast takes its origin from the lactiferous ducts leading to the nipple. The disease begins by a small swelling situated in the centre of the gland, and seldom causes retraction of the nipple. The tumor is more or less surrounded by a capsule formed by the dilated duct, which often is ruptured by tension. Small cysts are observed in this variety of cancer, the cyst-cavities contain mucoid fluid, and on the inner cyst-wall papillary growths are found. The axillary lymphatics may become involved, but not so frequently as in scirrhus, since the dense fibrous tissue prevents the cells from gaining access to the lymphatic spaces. The duct cancer may force its way through the skin and produce an ulcerating fungous mass.

The *medullary* carcinoma is one which is characterized by extreme richness of the epithelial elements and with little stroma.

Colloid carcinoma is a variety in which there exists a tendency for the cells to undergo colloid degeneration. This variety occurs in about 2 per cent. of the cases. The cells in the alveoli are destroyed by the formation of colloid globules. The stroma becomes œdematous, and cysts are often found in the tumor. It is due to these changes in the cells that the rapid tendency of the cancer toward malignancy is often arrested. The disease begins by the appearance of a lump in the gland. The swelling grows slowly, and may occupy many years before it attains any special size. The swelling is not usually accompanied by pain, and retraction of the nipple or dimpling of the skin are seldom observed.

The *melanotic* carcinoma of the breast is extremely rare. Williams did not observe one in his table of 2397 cases of mammary tumors. The disease is said to be less frequent in the male than in the female breast.

In order to intelligently understand the results of special operative procedures after amputation of the breast it is necessary to define with precision the terms "local" and "regionary recurrences" and "internal metastasis."

A *local recurrence* is a return of the carcinoma within the operative zone or in the cicatrix.

A *regionary recurrence* is a manifestation of carcinoma in the integument at a distance from the cicatrix. The regionary recurrences are supposed to be entirely independent of the primary tumor.

Internal metastasis is a recurrence of the carcinoma in a distant viscus, organ, or structure, the result of infection from the primary focus. In a given case of carcinoma, therefore, a return of the disease in the cicatrix, taken in its comprehensive sense, indicates a local recurrence; a return in the integument adjacent to the cicatrix indicates a regionary recurrence; the appearance of disease in the mediastinal glands, lung, liver, intestine, cord, or brain indicates an internal metastasis.

In removing a carcinomatous breast the clinical fact must ever be borne in mind that there is a zone of infection of greater or less extent which the eye cannot discern. The microscope, however, will reveal the presence of cancer-cells pushing their way into the surrounding structures. Raymond Johnson has shown that the extent of this zone-infection varies according "to the nature of the carcinoma and the character of the tissues around it." In the squamous variety of cancer the zone is circumscribed, and in glandular carcinoma of the breast the zone is more diffuse. The lymph-spaces beyond the carcinomatous nodule are filled with cancer-cells, which fact explains the presence of secondary deposits in breast cancer. The question comes to the front, in view of the pathological and microscopical demonstrations of recent months, whether it is not wise, after all, to remove the skin over the breast and avoid flaps, and heal the wound by an immediate skin-grafting. This is certainly to be advised where there are any shot-like nodules in the skin covering the mamma. The writer is convinced that the risks of recurrence are lessened by this operative procedure. The wound can be skin-grafted at the time of the operation. Mr. Harold J. Stiles of Edinburgh has devised a most ingenious method of ascertaining whether the entire carcinoma has been removed. The original article was given to the writer by Mr. John Chiene at the meeting of the American Surgical Society in 1891, and from this the writer will quote:

"THE NITRIC-ACID METHOD.—1. *Wash the mamma in water to remove all traces of blood.* This is important, because after treatment with nitric acid the blood becomes blackened and difficult to remove, and therefore greatly obscures the appearances which the method brings out.

"2. Submerge the *whole organ in a 5 per cent. aqueous solution of acidum nitricum, B. P.*, for about *ten minutes*—that is to say, during the time the surgeon is clearing out the axilla.

"3. Wash in plenty of running water for five minutes.

"4. Place in methylated spirit (undiluted) for two or three minutes.

"5. Examine the whole surface very carefully to ascertain—

"(*a*) Whether any part of the tumor itself be exposed upon the surface;

"(*b*) Whether any locally disseminated cancer-foci be exposed upon the cut surface;

"(*c*) Whether breast-tissue be exposed.

"The effect of the above method is to render all *carcinomatous* tissue and *parenchyma* dull and *opaque white*, due to coagulation of the albumin of the protoplasm of the cancer and epithelial cells.

"The *fibrous tissue of the stroma* is rendered *gelatinous, translucent, and homogeneous* in appearance, and somewhat India-rubber-like in consistence.

"The *fat* is *unaltered*.

"After examining the surface of the organ it should be cut into thick slices, and these are to be treated again in the same way.

"In this way the various normal and pathological constituents of the mamma can be readily and most satisfactorily studied.

"Cancer and parenchyma can at once be detected, if present, upon the surgeon's cut surface, and, since the examination can easily be completed before the time for suturing the wound, we have in this method a means which affords the surgeon a valuable aid in ascertaining the limits of the disease and of the organ.

"In two cases recently operated on by Professor Chiene, I was able to point out to him a speck of cancer no larger than a pin's head exposed upon the cut surface of the mamma. A corresponding point of the wound was searched, and in each case the remainder of the disease was discovered and removed. I possess microscopic preparations proving their cancerous nature.

"It is necessary to point out, however, that even although no locally disseminated foci may be discovered upon the surgeon's cut surface, the prognosis is not necessarily good, because, as we have already seen, the presence of lymphatics containing cancer-cells cannot be detected with the naked eye.

"For a subsequent more exhaustive study of the parts I have been in the habit of replacing the slices in the nitric-acid solution for a few hours, and subsequently washing for an hour or so. The specimen may then be placed in undiluted methylated spirit (which becomes brown, and should be renewed at the end of twenty-four hours), and the appearances are permanently retained.

"Excellent drawings may be made from specimens so prepared, and they afford the only illustrations I have seen in which accurate detail and differentiation have been brought out.

"In microscopic investigation of tumors of the breast we have in the nitric-acid method a means which enables us to select exactly those portions of tissue which are most likely to illustrate special points, and in this way much time and labor is saved.

"Those slices, however, from which pieces are to be selected for microscopic examination must not be allowed to remain in the acid solution for more than a few minutes, as the acid renders the tissue too hard for section-cutting."

The question of opening the axilla as a routine measure in amputation of the breast is one which deserves to be considered upon both sides. Poulson reported 21 cases in which the breast was amputated and the axilla was not opened. All of these cases remained free from return, so as to comply with the three years' limit of time.

Curtis believes "that it is not necessary to be extravagant in order to be thorough, and that it is possible in certain cases to obtain lasting cures by conservative methods which will spare the patient unnecessary mutilation."

Prof. Humphrey of Cambridge narrated to the writer the case of a lady who had a cancer of the breast which was removed. Soon after healing there was a return of the disease near the cicatrix. This was freely removed. Ten years after there was again a return of the disease near the cicatrix. This was removed, and no further return in that region, but she died of cancer of pelvic and thigh bones.

Prof. Humphrey said to the writer, in the course of conversation, "that it is much more important to make a free removal of the mamma with its surroundings than to open the axilla, unless there be evidence of implication of the axillary glands, because it is more frequent to have return in neighborhood of the cicatrix than in the glands when the latter have not been removed."

In the course of conversation with Mr. Pepper of St. Mary's Hospital he stated to the writer that Mr. Lawson of Middlesex said that if glands were not obviously affected he would not open the axilla, and if only one gland was enlarged, he would remove only that gland, otherwise opening the axilla was unjustifiable. Notwithstanding these contradictory views from eminent authorities, the writer still advises unhesitatingly the removal of glands in the axilla, as well as the other structures named, at the time of amputation of the breast.

The necessity of removing the pectoral muscle is evident when it is considered, as Ludwig has demonstrated, that carcinomatous cells may enter the lymphatic vascular system belonging to the muscle.

Volkmann has pointed out the necessity of removing the pectoral fascia, since the cells may be imbedded in the fascia and not necessarily invade the pectoral muscle. The lymphatic vessels lie upon and in the fascia, and in some cases do not follow the blood-vessels into the intermuscular septa. This anatomical fact explains the immunity from infection in the pectoral muscle, although the fascia is invaded.

Schweigger and Seidel have shown that a plexiform arrangement of the lymphatic vessels lies upon the superficial surface of the fascia and upon the muscle itself. Küster operated upon 226 cases of carcinoma of the breast, in which 22 were bound down to the thoracic parietes, and of these 22 cases not one was permanently cured.

The absence of adhesion, however, does not necessarily imply that the pectoral muscle is not infected, although the presence of adhesions makes it more than probable that such is the case.

The question as to whether the glands in the posterior cervical triangle should be extirpated is one about which there is no unanimity of opinion. The lymphatics from the apex of the axilla enter the posterior triangle, and infiltration of these nodes occurs in consequence of this anatomical arrangement. From this triangle the lymphatics enter the thoracic duct on the left side, as well as the thoracic duct upon the right side.

In addition to this avenue along which infection may be carried, it must be borne in mind that the mammary skin-lymphatics also enter the posterior cervical triangle. There is thus a twofold connection between

the breast and the lymphatics of this triangle. Dr. Robert Sanderson advocates the clearing out of this triangle by means of the formation of a triangular skin-flap made by cutting down along the border of the sterno-mastoid muscle, and then along the clavicle back as far as the anterior border of the trapezius muscle.

It has been urged by the opponents of the so-called radical operation that the surgeon should extend his field of operation to the mediastinal glands. This extension of the field of operation seems unwise in the majority of the cases, not only on account of the great danger of the operation itself, but also on account of the fact that carcinoma seldom affects the inner vertical hemisphere of the breast, as statistics show that generally carcinoma of the breast affects the outer and upper segment, or that part in direct lymphatic connection with the axilla.

Carr has suggested that in amputation of the breast the axilla should be first opened and the lymphatics be removed, "so as not to force any cancerous material or cells from the axilla into the deeper tissues while manipulating the breast. Remove the axillary contents in one mass by clean cutting with a sharp knife and without puckering or pulling; extend the incisions down over the tumor, so as to enclose and remove all diseased skin and a considerable margin, at least an inch, of healthy skin."

In dissecting out the axillary gland it is best for the surgeon to take another scalpel, since the danger of infection has been recently demonstrated in the following case: The writer had under his charge recently a case in which recurrence of the disease occurred in V-shaped cicatrices situated above and below the cicatrix of the original wound. These two cicatrices were due to incisions to relieve tension in the flaps in consequence of the necessity arising from the removal of considerable skin. If infection can occur in such a way, is it not possible to infect the axilla with a scalpel used in the performance of excision of the breast? At all events, such a case suggests the necessity of dissecting out the axillary gland with a knife that has not been used during the operation upon the breast itself. This patient was operated upon by a colleague to whom the case was referred.

The importance of a radical operation is forcibly emphasized by Volkmann, to whom the profession is greatly indebted for directing attention to the causes of failure in the inadequate and formerly stereotyped operation of amputation of the breast. Volkmann wrote as follows: "I make it a rule never to do a partial amputation for cancer of the breast, but remove the entire breast, even for the smallest tumors, and at the same time I take away a liberal piece of skin. The skin-defect is, of course, very great when one operates in this manner, and the wound, in consequence, requires a long time for healing. Furthermore, in making the lower incision I cut right down to the pectoralis muscle and clean its fibres, as I would for a class-room dissection, carrying the knife parallel with the muscular fasciculi and penetrating into their interstices. The fascia of the muscle is, accordingly, entirely removed. I was led to adopt this procedure because on microscopical examination I repeatedly found when I had not expected it that the fascia was already carcinomatous, whereas the muscle was certainly not involved. In such cases a thick layer of apparently healthy fat separated the carcinoma from

the pectoral muscle, and yet the cancerous growth, in places demonstrable only with the microscope, had shot its roots along the fibrous septa down between the fat-lobules and had reached and spread itself out in flat islands in the fascia. It seems to me, therefore, that the fascia serves for a time as a barrier, and is able to bring to a halt the spreading growth of the carcinoma."

The operative technique of amputation of the breast according to Halsted's excellent method is given in his own words, together with the diagrams illustrating the different steps of the operation:

"The operation which has been attended with such surprisingly good results in our hands is performed as follows:

"1. The skin incision is carried at once and everywhere through the fat.

"2. The triangular flap of skin, *ABC* (*vide* Fig. 435), is reflected back to its base line, *CA*. There is nothing but skin in this flap. The fat which lined it is dissected back to the lower edge of the pectoralis major muscle, where it is continuous with the fat of the axilla.

FIG. 435.

Diagram showing skin-incisions: triangular flap of skin, *A B C*, and triangular flap of fat (Halsted).

"3. The costal insertions of the pectoralis major muscle are severed, and the splitting of the muscle, usually between its clavicular and costal portions, is begun, and continued to a point about opposite the scalenus tubercle on the clavicle.

"4. At this point the clavicular portion of the pectoralis major muscle and the skin overlying it are cut through hard up to the clavicle. This cut exposes the apex of the axilla.

"5. The loose tissue under the clavicular portion (the portion usually left behind) of the pectoralis major is carefully dissected from this muscle as the latter is drawn upward by a broad, sharp retractor. This tissue is rich in lymphatics, and is sometimes infiltrated with cancer (an important fact).

"6. The splitting of the muscle is continued out to the humerus, and the part of the muscle to be removed is now cut through close to its humeral attachment.

"7. The whole mass, skin, breast, areolar tissue, and fat, circumscribed by the original skin-incision is raised up with some force, to put the submuscular fascia on the stretch as it is stripped from the thorax close to the ribs and pectoralis minor muscle. It is well to include the delicate sheath of the minor muscle when this is practicable.

"8. The lower outer border of the minor muscle having been passed and clearly exposed, this muscle is divided at right angles to its fibres and at a point a little below its middle.

"9. The tissue, more or less rich in lymphatics and often cancerous, over the minor muscle near its coracoid insertion is divided as far out as possible, and then reflected inward in order to liberate or prepare for the reflection upward of this part of the minor muscle.

"10. The upper, outer portion of the minor muscle is drawn upward (*vide* Fig. 436) with a broad sharp retractor. This liberates the retractor, which until now has been holding back the clavicular portion of the pectoralis major muscle.

FIG. 436.

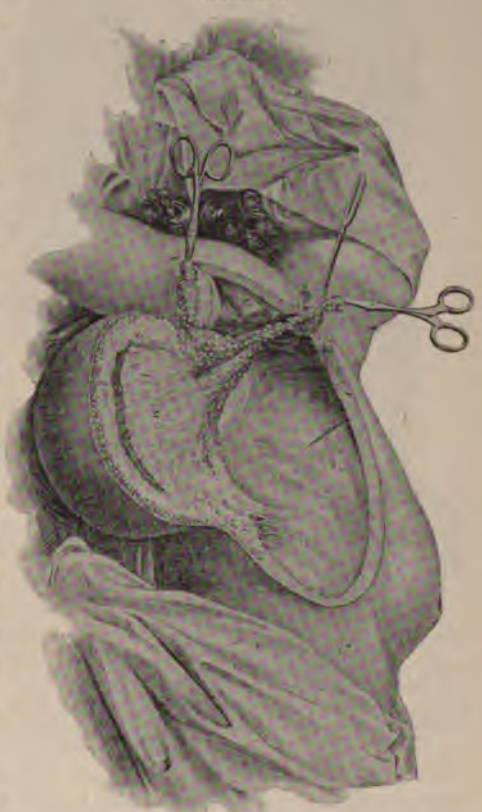


Diagram showing skin-incisions: triangular flap of skin, *A B C*, and triangular flap of fat (Halsted).

"11. The small blood-vessels (chiefly veins) under the minor muscle near its insertion must be separated from the muscle with the greatest care. These are imbedded in loose connective tissue, which seems to be rich in lymphatics and contains more or less fat. This fat is often infiltrated with cancer. These blood-vessels should be dissected out very clean and immediately ligated close to the axillary vein. The ligation of these very delicate vessels should not be postponed, for the clamps occluding them might of their own weight drop off or accidentally be pulled off or the vessels themselves might be torn away by the clamps. Furthermore, the clamps, so many of them, if left on the veins, would be in the way of the operator.

"12. Having exposed the subclavian vein at the highest possible subclavicular point, the contents of the axilla are dissected away with scrupulous care, also with the sharpest possible knife. The glands and fat should not be pulled out with the fingers, as advised, I am sorry to say, in modern text-books and as practised very often by operators. The axil-

lary vein should be stripped absolutely clean. Not a particle of extraneous tissue should be included in the ligatures which are applied to the branches, sometimes very minute, of the axillary vessels. In liberating the vein from the tissues to be removed it is best to push the vein away from the tissues, rather than, holding the vein, to push the tissues away from it. It may not always be necessary to expose the artery, but I think that it is well to do this, for sometimes, not usually, the tissue above the large vessels is infiltrated. And we should not trust our eyes and fingers to decide this point. It is best to err on the safe side, and to remove in all cases the loose tissue above the vessels and about the axillary plexus of nerves.

FIG. 437.

Figure showing "the glands, although involved, were not surely palpable before the operation" (Halsted).

"13. Having cleaned the vessels, we may proceed more rapidly to strip the axillary contents from the inner wall of the axilla—the lateral wall of the thorax. We must grasp the mass to be removed firmly with the left hand and pull it outward and slightly upward with sufficient force to put on the stretch the delicate fascia which still binds it to the chest. This fascia is cut away close to the ribs and serratus magnus muscle.

"14. When we have reached the junction of the posterior and lateral walls of the axilla, or a little sooner, an assistant takes hold of the triangular flap of skin and draws it outward, to assist in spreading out the tissues which lie on the subscapularis, teres major, and latissimus dorsi muscles. The operator, having taken a different hold of the tumor, cleans from within outward the posterior wall of the axilla. Proceeding in this way, we make easy and bloodless a part of the operation which used to be troublesome and bloody. The subscapular vessels become nicely exposed and caught before they are divided. The subscapular nerves may or may not be removed, at the discretion of the operator. Küster lays great stress upon the importance of these nerves for the subsequent usefulness of the arm. We have not as yet decided this point to our entire satisfaction, but I think that they may often be spared to the patient with safety.

"15. Having passed these nerves, the operator has only to turn the mass back into its natural position and to sever its connection with the body of the patient by a stroke of the knife from *b* to *c*, Fig. 435, repeating the first cut through the skin."

The writer does not take such a melancholy view of the results of operations for the relief of cancer of the breast as has been handed down by tradition. Halsted remarks that Gross did not effect a permanent cure in his first series of 100 cases, and that Hayes Agnew operated for the moral effects only, and that he firmly believed that life was shortened and not prolonged by the operation. Many surgeons claim that they have never permanently cured a patient suffering from carcinoma of the breast. These are statements based on an experience in which inadequate and incomplete operations were attempted. As the science of pathology has developed, as the knowledge of bacteriology has increased, as the technique of operation has improved, in the same proportion the onward march toward brilliant achievement and lasting result has been made. The knowledge in all these collateral sciences has made it possible for surgery to effect cures in the treatment of this disease.

The writer has had 116 cases of tumors of the breast, of which 19 were not operated upon, leaving 97 cases in which the breast was amputated. In the 97 cases of amputation there was but 1 death, thus giving a mortality of a little over 1 per cent. The one fatal case was due to the presence of hæmophilia, and is a death that might have occurred in connection with any other operation, no matter how insignificant in character. This death can, therefore, with propriety, be excluded as far as bearing upon the mortality of this special operation; and, if so, there is an unbroken series of 96 consecutive operations without a single death. In addition to the reduction of the mortality of the operation from as high as 23 per cent., recorded by Billroth, to a cipher, there was no case of pyæmia, septicæmia, erysipelas, or abscess.

Of the 97 cases of amputation of the breast, 23 cases of sarcoma and of other tumors than cancer must be eliminated in order to compute the percentage of permanent cures of pure carcinoma of the breast. Of the 74 cases of pure carcinoma of the breast, the subsequent history of 41 is known, and 3 of these have not yet reached the three years' limit of time, although they are still alive and free from the disease. There remain 38 cases, therefore, of pure carcinoma of the breast in which the full subsequent histories are known. In these 38 cases there are 17 cases in which a permanent recovery has taken place, allowing the three years' standard of time to have been reached. This gives 45 per cent. of permanent cures. Among these 38 cases whose histories are known, there were but 2 local recurrences, which gives but a little over 5 per cent. of local recurrences.

Since the publication of the writer's last statistics in 1891 he has had 15 cases of pure carcinoma of the breast, with no mortality from the operation itself. Of these 15 cases, 1 died several weeks following the operation from hæmophilia, in which the major joints were filled with blood and the greater part of the body was affected with subcutaneous hemorrhages; 2 of these cases have not reached the three years' limit of time. There are, therefore, 12 cases in which the full subsequent histories are known; 2 of them suffered from a recurrence of the disease,

and the remaining 10 have passed the three years' limit of time. This gives 83 per cent. of permanent cures in cancer of the breast in the last 15 consecutive cases.

The reason why these heroic measures have not been hitherto employed in amputation of the breast lies in the fact of the mortality of the operation, since Gross reports 10 per cent. mortality; Sir Joseph Lister, 8 per cent.; Butlin, 7 per cent.; Fischer, 20 per cent.; Esmarch, 10 per cent.; Küster, 14 per cent.; Billroth, 15 per cent., and in one list 23 per cent. In my list of cases of amputation for all kinds of tumors of the breast the mortality of the operation is less than 2 per cent. This mortality includes the results after a radical operation. If this represents the mortality, there is no longer any reason for surgeons to offer the dangers of the mortality of the operation as an excuse for the non-performance of a radical operation, since it is in those cases in which a most complete operation has been performed that permanent recoveries follow.

CYSTIC DEGENERATION OF THE BREAST may appear under the form of a general enlargement of the breast, with no disturbance in the nipple or upon the integument over the gland, or any axillary induration, or the disease may appear with a circumscribed cyst in the breast, associated with axillary induration and retraction of nipple, or cystic degeneration may present in the form of multiple cysts attended by a discharge of a yellow or bloody nature or even of a thickened cheesy material.

Bloody fluid may occur in cysto-sarcoma, and in some cases a yellow fluid may be discharged from the nipple in certain types of malignant disease of the breast. The presence of a discharge from the nipple in a young woman whose breast is not functionally active may therefore point to the presence of a cyst or to malignant disease. The mere fact of a discharge from the nipple is not, therefore, a reliable guide as to the character of the tumor in the breast.

CYSTIC DISEASE OF THE BREAST.—In connection with every disease of the breast cysts may be found. These are accidental, and occur in the course of the development of the neoplasm. By cystic disease of the breast something else is meant besides this incidental formation, and a consideration of the subject leads to a study of the formation of cysts in the breast independent of tumor-growth. The pure cystic disease occurs in about 2 per cent. of the cases of mammary tumors, according to Williams.

The different varieties of cysts are those termed involution-cysts, of which there are several subdivisions, among which may be mentioned the connective-tissue, the duct, the hemorrhagic, the serous, and the mucoid. Hydatid cysts are also considered in this connection, although having a different origin from those just enumerated.

The *involution-cysts* are the result of atrophic senility of the gland. The disease is independent of any proper tumor-formation. The disease, although it may occur in young women, is usually observed in women after fifty and not after sixty. The cysts are multiple and contain a brownish mucoid fluid. They are usually small, and vary in size from a millet to a melon-seed, and in some cases attain even larger proportions. They are either the result of inflammatory changes due to a previous chronic interstitial mastitis or due to the ordinary senile changes incident

to the change in the degeneration of the gland. These small cysts are usually found upon the periphery of the gland, and follow the general direction of the lactiferous ducts toward the nipple.

The *connective-tissue cyst* is formed in the periglandular tissue, and is developed in consequence of an extravasation of fluid in the meshes of the connective tissues surrounding and holding together the various lobes and lobules. The cyst grows slowly, has thick walls, and is usually solitary. The fluid within the sac is usually clear and transparent, but may be dark or coffee-colored from extravasation of a few drops of blood from the cyst-wall as a result of traumatism. This variety of cyst is often mistaken for solid tumor of the breast, notably scirrhus. The absence of darting pains, the stony feel and lymphatic enlargement, and the length of time that the tumor has existed enables the surgeon to distinguish between the two affections. The introduction of a sterilized hypodermic needle into the cyst will clear up any doubt as to the character of the swelling.

The **treatment** of these cysts consists of excision of the cavity if the patient is young and the cyst small, solitary, and painless, or amputation of the breast if the cyst is large or multiple and the patient at or beyond the menopause. This step seems necessary in view of the fact that degeneration of these cysts into malignant disease has been observed.

DUCT CYST OF THE MAMMARY GLAND was first described by Sir Astley Cooper, to which description Sir Benjamin Brodie made some valuable additions.

Reclus in 1883 still further added to our knowledge of the subject. The duct cyst has been fully described by Birkett, to whom the profession is indebted for much valuable information in connection with this disease.

The chief clinical feature of this variety of cyst is the danger of its being transformed into an adenoma or even a duct epithelioma.

The *duct cyst* is formed by obstruction of a milk-duct, which soon leads to dilatation. The duct is generally one of the smaller tributaries to a larger duct terminating at the nipple.

When the smaller ducts are involved the cysts are generally multiple, and when only one large cyst is present it is usually connected with the larger duct. The cyst soon grows to be a round or ovoid swelling more or less tense, and is generally lined with columnar epithelium. The fluid within the cyst is generally serous and clear, but if the sac is injured the clear fluid becomes coffee-colored or blood-stained. The escape of the fluid from the nipple indicates that the cyst takes its origin either from a dilated duct or from a gland in the structure of the mammæ.

The duct cyst begins as a small round or ovoid tumor which is situated in the glandular organ, and is to a greater or less extent movable under the skin, since it has formed no cutaneous adhesions. A most important fact to remember is the round form of the tumor, which with an elastic feel distinguishes it from a solid neoplasm. The disease is most frequently seen between thirty and forty years of age, and often affects both breasts.

The duct cyst of the breast must not be mistaken for tubular carcinoma of the cystic variety or multiple papilloma. In the cystic tubular carcinoma only one breast is affected as a rule, and the lymphatics

are involved, while in papilloma of the cystic variety a bloody discharge generally escapes from in nipple. As the duct cyst is often multiple: there is no well-defined induration, as in carcinoma.

The **treatment** of duct cyst consists in excision of the sac. If it is practicable, Thomas's operation, which consists of cutting a flap formed of areola and nipple with the base upward, should be performed. This flap is dissected up and the cyst completely removed. The flap can then be brought down in its proper place, and no scar is visible over the front of the breast. If this method is not applicable, it is better to remove the entire breast, since at the climacteric a cyst of this variety may become transformed into malignant disease of the cystic variety.

Occasionally these cysts have been tapped and compression applied. It is better to remove the sac on account of the possible danger of the development of malignant disease at some future time.

The *hemorrhagic* cyst—or blood-cyst, as it is sometimes called—is usually developed as a result of a hemorrhage into a previously formed cyst in connection with some tumor, or of this same cause acting in conjunction with an injury to an intracystic growth within a cyst. These hemorrhagic cysts are seen in chronic mastitis, and by some pathologists are considered the forerunner of acinous epithelioma.

Valude reports a case in which a chronic mastitis led in two years to the development of epithelioma. This observation, as well as one of the same kind by Sir William MacCormac, leads the practical surgeon to believe that there is a causal relation between blood-cysts and carcinoma. The thickening of the connective tissue in these cases is due to the irritation from the presence of the cyst. While it is true that many of these cases of blood-cysts in connection with chronic interstitial mastitis may remain innocuous for a long period, yet such a condition present in a woman who has attained the climacteric, and especially if she has any hereditary tendency to cancer, calls for an operation of no less magnitude than complete removal of the entire breast.

The **treatment**, therefore, consists in a radical operation. The step seems wise in view of the fact of the exceedingly low mortality of the operation, and the dangers of malignant disease following a partial excision.

The *serous cyst* is usually solitary, although around it may be found many very minute cysts. The fluid in the cyst is straw-colored, like that contained in a hydrocele. The breast itself shows evidences of an interstitial mastitis. If the cyst is situated in the centre of the gland and becomes tense with fluid, and over it lies sclerosed glandular tissue, the feel of the swelling may closely resemble a scirrhus of the breast—a mistake which has been made, and for which amputation of the breast has been performed.

The cyst is lined with cubical epithelial cells, or in exceptional cases with pavement epithelium. In cases of doubt as to the presence of a serous cyst or a scirrhus a sterilized exploring needle may be used.

The **treatment** consists in aspirating the cyst and then cauterizing the cavity with a chloride-of-zinc solution through an opening made into its interior, or the cyst can be completely excised and the wound packed with iodoform gauze or else closed by deep sutures. The question of

amputating the breast must be considered instead of aspiration and cauterization or deep suture, since these cysts may degenerate into malignant neoplasmata during the changes incident to age. The presence of chronic interstitial mastitis with pain would direct serious attention to the propriety of excision of the entire gland.

Mucoid cysts develop in the small mucous glands situated in the mucous membrane. The wall of the cyst is extremely thin, and is intimately connected with the surrounding structures. The outer layer of the cyst-wall is made up of fibrous tissue, and the interior or lining membrane is covered by a layer of epithelium. The cyst contains an albuminous fluid resembling that found in a hydrocele. The fluid contents of the cyst are mixed with a deposit of fat-globules, broken-down epithelial cells, and corpuscles of Glüge. The cyst forms a small elastic swelling, generally of an ovoid shape. From the nipple is often squeezed out a few drops of the fluid, especially if the cyst is situated near the areola and nipple. The escape of fluid from the nipple is an important diagnostic sign, inasmuch as it indicates the origin of the cyst.

The **treatment** of this variety of cyst is substantially the same as that already mentioned for the relief of connective-tissue cysts.

Hydatid cyst of the breast is an exceedingly rare affection, since there are only about 25 cases recorded. The cyst may be situated in any part of the breast except in the areola and nipple. It is unilateral and is usually solitary, and grows very slowly, often occupying many months and even years on account of the resistance offered to it by the dense fibrous stroma of the gland. How the parasite gains access to the breast is still a question *sub judice*, but there is good ground to believe that the parasite may gain access to the gland in the same manner that the streptococci and staphylococci do in abscess of the breast—viz. through the nipple.

The hydatid cyst is formed of a parent vesicle in which are many scolices. In the interior of the parent cyst daughter cysts develop. The fluid is clear and alkaline in reaction, with a specific gravity of about 1008, and is unlike that found in the other variety of cysts of the breast in that it is non-albuminous and contains hooklets which are pathognomonic of the special variety.

The hydatid cyst forms a painless, elastic swelling which is globular in shape, and by its mechanical effect causes a certain amount of inconvenience. The hydatid cyst of the breast does not grow, as a rule, to be of great size, although there are certain cases reported where the cyst weighed twelve and fourteen pounds. No fluid escapes from the nipple in this variety of cyst, as is the case in duct and mucoid or lacteal cysts.

The **diagnosis** is made certain by a microscopical and chemical examination of the fluid, which may be drawn by a hypodermic needle. It occasionally happens that hydatid cysts take their origin from the pectoral muscle or even spring from the thoracic cavity.

The **treatment** consists of complete excision of the sac. The wound can be left open so as to heal from the bottom. Into the bottom of the cavity a tampon of iodoform gauze may be packed and the dressing changed from time to time. If the cyst cannot be completely excised, the entire breast should be amputated.

Surgery of the Female Nipple.

In studying the diseases of the nipple the anatomy and malformation will be first considered; the functional disorders and the inflammatory affections next; and, finally, the diseases and tumors. In this way the same order will be observed as has been followed in connection with the breast.

Anatomy of the Female Nipple.—The nipple is the conical projection from a point a little below the centre and the outer side of the gland. It is the point of emergence for the lactiferous ducts, which open upon it between the rugæ of the skin, upon the level with the lower border of the fourth rib. The elevation of the nipple above the summit of the gland varies in different individuals. In the virgin it projects forward and outward, and after pregnancy downward. In some women the nipple rises only a short distance from the skin, while in others it is of considerable length, and in both of these extremes there is difficulty in suckling.

The nipple is surrounded by a circular belt of pink or dark-colored skin which is called the areola, and which is usually about two inches in diameter. Its pink color is found in the virgin, and the dark color following the second month of pregnancy, due to the presence of pigment-cells in the Malpighian layer of the skin (Figs. 425 and 426).

The anatomical arrangement of the nipple consists of a retiform tissue composed of minute vessels and unstriped muscular fibres. The entire mass forms a sheath around the nipple-ducts and the ampullæ, and extends backward for a little distance and surrounds the lactiferous ducts. The lobes are independent of each other, which anatomical fact explains the multilocular abscesses.

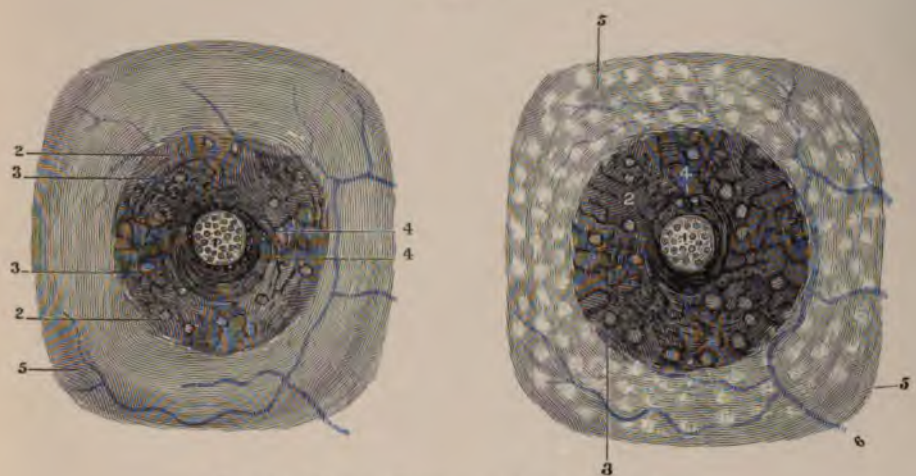
The nipple is supplied with vascular and lymph-vessels and nerves, the latter of which are derived from the anterior and middle branches of the third, fourth, and fifth intercostal nerves, while the skin in the periphery of the breast returns the supply from supraclavicular branch of the cervical plexus. If often happens that acute neuralgia affects these nerves, and this erroneously gives rise to the opinion that the breast itself is the seat of the disease.

A few lymph-channels accompany the intercostal veins into the anterior mediastinum and join the glandulæ sternales situated in the first three intercostal spaces. A larger number pass direct to the axilla behind the edge of the pectoralis major muscle. From the areola and nipple lymph-channels pass to a gland situated near the clavicle. Among the papillæ of the nipple are corpuscles between which are large-sized sebaceous glands known as "Montgomery's glands," the function of which is to lubricate the nipple and protect it from the irritating discharges of the child's mouth. At the base of the nipple are situated small glands known as the glandulæ lactiferæ aberrantes. These glands are the orifices of the lactiferous ducts from small lobules in the breast. Just before emerging at the base of the nipple the duct expands so as to form a pocket or pouch, which is known as the sinus lacteus.

Upon the surface of the areola are seen numerous papillæ which during pregnancy, and especially during lactation, are very conspicuous.

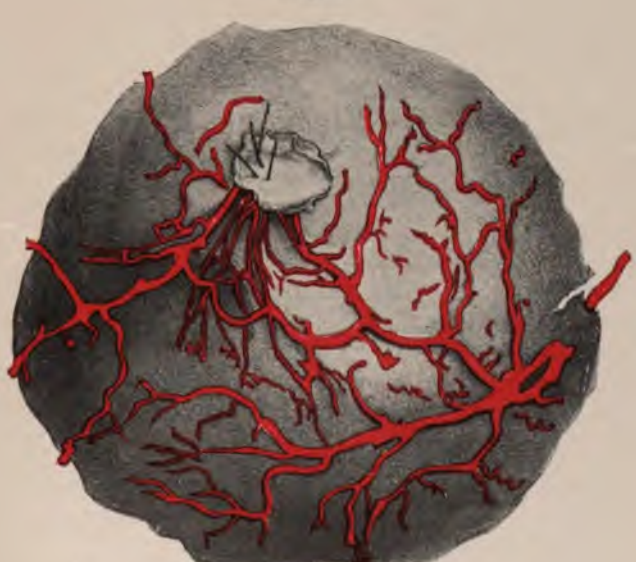
PLATE XVII.

Fig. 1.



Showing Venous Supply of Nipple. (TESTUT.)

Fig. 2.



Showing Arterial Supply of Nipple. (COOPER.)

Papillæ are the mouths of the underlying lactiferous ducts from the glands, which during lactation secrete a whitish fluid. Around the outer circumference of the areola these papillæ are especially prominent, and a few hairs are seen emerging from the slight projections. These hairs are surrounded by sweat-glands similar to those found upon the skin.

The oblique projection of the nipple forward, outward, and slightly upward is nature's provision for the infant to suckle, while the mother at the same time can support her offspring against her side and in her arms, and, on the other hand, one side of the child's face rests upon the inferior part of the breast, which "forms a cushion upon which the cheek of the infant tranquilly reposes." If the nipple were situated so as to point forward only, it would necessitate the mother holding the child in her hands during the act of suckling, while in this situation the mouth of the child could not grasp the nipple.

ANOMALIES OF THE FEMALE NIPPLE.—It occasionally happens that the nipple is absent, a condition to which the term athelia has been given. This deformity may exist without a corresponding malformation of the gland, and may affect both breasts. In some cases of athelia women have become pregnant and the breasts have secreted a large quantity of milk, but they were incapacitated for suckling. In place of the nipple there is sometimes found a small horizontal sulcus, such as is observed during the early fœtal development of the breast. The nipple is occasionally bifid, and sometimes imperfectly developed, so that attempts have been made to elongate the nipple by artificial means in the way of breast- or suction-pump. This is only to be tried in cases of pregnancy, and not in the virgin.

In some cases of athelia the condition is congenital, and is associated with other malformations which are due to arrest of development. There are cases reported of athelia in which there was no hair on the mons Veneris, and absence of a normal vagina, with no evidences of ovaries or uterus.

Instead of athelia, it often happens that the nipple is deformed or distorted so that it is unable to perform its function. These conditions give rise to abscesses in the breast, and Birkett has pointed out the clinical fact that nearly one-half of the cases of acute abscess of the breast are found in patients with some defect in the nipple. These malformations may be congenital or occasionally may be due to injury of some kind. In athelia the areola is often absent or at least it is imperfectly developed.

Besides absence and malformations of the nipple there is observed a supernumerary nipple. Usually the extra nipple is situated about three inches from the original nipple, although the distance varies from one to eight inches (Fig. 438).

BURNS may involve the nipple, and are serious if the damage is sufficient to destroy the lactiferous ducts terminating in the nipple, either directly in consequence of the burn or indirectly from cicatricial contraction.

DISCHARGE FROM THE NIPPLE may occur during pregnancy, in which case the fluid is colostrum and of no special significance. It may also exude from the nipple of an infant of either sex, in which

case the breast should not be manipulated, for fear of developing an abscess from friction and sepsis, the latter of which is derived from the nurse's hand. The discharge is harmless at this period of life, and is of no clinical importance. A discharge often occurs in connection with menstrual irregularities, or with some unhealthy condition of the gland, or with some disease of the pelvic organs.

FIG. 438.

Extra nipple on the breast.

A discharge of blood-colored serum is often an early diagnostic sign of cancer. A discharge of a mucoid fluid which is often tinged with blood, and in rather profuse quantity, is indicative of cystic disease of the gland. The discharge may occur spontaneously or it may be due to improper manipulation. The presence of the mucoid discharge eliminates the probable existence of a solid tumor like sarcoma or fibroma, but points to cystic disease or to a cystic formation occurring incidentally in connection with a solid neoplasm.

The fluid should always be subjected to microscopical examination, since it has been demonstrated that bloody fluid containing cells akin to the epithelial cells in cancer indicates the presence of this malignant disease, while a yellow, transparent fluid points to the existence of a cystic adenoma or even an ordinary simple involution-cyst. Fluid contained in a hydatid cyst never exudes from the nipple, but by exploratory puncture the fluid can be obtained.

ECZEMA OF THE NIPPLE may occur and run the ordinary course, but if it resists all the usual remedies the disease is grave, since it will give rise to Paget's disease of the nipple. The ordinary remedies, both constitutional and local, should be given a fair trial, and if the disease fails to respond to the treatment, the question of operation must be considered. Authorities differ as to the extent of the operation. The writer has no hesitation in advising complete removal of the entire breast in any case where a persistent eczema continues to remain notwithstanding the application of measures directed to its relief. This radical operation is especially indicated if there is any induration radiating from the nipple. This opinion is formed after a careful study and an extensive practical experience with the disease. The danger of leaving a breast behind after excision of the nipple for a chronic eczema is great, since epithelioma is almost certain to follow. The pain and inflammatory disturbance in the gland in case lactation should occur, and the utter uselessness of the gland without the nipple, coupled with the infinitesimal mortality attending the operation, more than counterbalances the sentiment of the patient. This radical measure is far better than palliative treatment or inadequate operation. Carcinoma of the

breast has been shown to start from eczema of the nipple, and an incurable attack justifies even so radical an operation as amputation of the entire breast when all other measures have failed. Among the simple remedies which are generally employed are antiseptic solutions, such as carbolic acid 1 : 20, bichloride of mercury 1 : 500, followed by the application of some simple ointment or powder. Over the nipple a well-ventilated shield should be worn to avoid friction of the clothes against the sensitive organ.

To avoid repetition, Paget's disease of the nipple is considered in connection with Epithelioma of the Nipple, presently to be discussed.

WARTS are found upon the nipple and areola: they may be papillary or pedunculated.

In a collection of 2397 mammary tumors made by Williams there were only 3 cases of papilloma of the nipple.

CHANCRE OF THE NIPPLE is occasionally observed. There is no special distinguishing feature of chancre in this locality, and its treatment is the same as chancre affecting the prepuce. The chancre of the nipple is usually solitary, but when found on the breast may be multiple. Taylor has observed as many as "sixteen chancres on the right and seven on the left mammary areola."

EPITHELIOMA OF THE NIPPLE may occur in consequence of the irritation due to the presence of an intractable eczema. This form of epithelioma has been termed Paget's disease of the nipple.

Williams states that only about 1 per cent. of the cases of carcinoma of the breast involve the nipple and the areola.

The eczema is different from a simple eczema observed in other parts, since in this affection of the nipple the usual conditions are absent, such as irritable and dry skin, over-work, anxiety, faulty innervation, nerve-disorder in vessels and tissues, the uric or gouty diathesis, deficient kidney action, biliary exudation, and dyspepsia. On the other hand, "Paget's disease of the nipple" may arise independent of physiological activity in the breast or of peripheral irritation. It occurs where there is no mechanical congestion of the vessels—a condition which so often develops eczema in other parts, of which eczema in varicose veins is an illustration. It is also found where there is no friction and moisture, another condition so likely to develop ordinary eczema in the groin and perineum. Again, Paget's disease of the nipple is seen without the presence of any disorder of the internal organs, such as albuminuria, glycosuria, gout, icterus. Moreover, there is no clear line of demarcation between epithelial accumulation in the lactiferous ducts and upon the surface of the nipple. Finally, this disease does not disappear by the use of those means by which simple eczema is relieved. It is a local affection at first, and by its continued irritation causes epithelial proliferation in the lactiferous ducts. The eczema is at first a chronic affection of the skin about the nipple and areola, and never extends deep into the tissues, since the erosion is superficial. This form of eczema occurring in women who have passed the climacteric is very likely to give rise to epithelioma, and there is no reason to suppose that the eczema is secondary to breast epithelioma, since the eczema antedates any signs of epithelioma in the ducts.

No better clinical description of Paget's disease of the nipple can be

given than the one given by this eminent surgeon himself, who describes the disease as having "the appearance of a florid, intensely red, raw surface, very finely granular, as if nearly the whole (Plate XIV., Fig. 3) thickness of the epidermis were removed, like the surface of very acute diffused eczema or like that of an acute balanitis. From such a surface there was always copious, clear, yellowish, viscid exudation. In some cases the eruption has presented the character of an ordinary chronic eczema or psoriasis, the eruption spreading beyond the areola in widening circles or with scattered blotches of redness covering nearly the whole breast. The eruption has resisted all treatment, both local and general, and has continued even after the affected part of the skin has been involved in the cancerous disease."

CALCIFICATION OF THE ARTERY of the nipple has been observed by Sir Astley Cooper, who presented to the museum of the Royal College of Surgeons a most beautiful example. In this specimen, which the writer had an opportunity to observe, there was a section of the artery about five inches in length in the coats of which were imbedded thin plates and rings of calcareous matter. Another specimen illustrated the same morbid condition. The pathological changes in the nipple and areola are the same as would be expected in any other tissue in which a diminished blood-supply existed.

Sokalow reports a case of leiomyoma of the right nipple. Fibroma molluscum has also been observed by the writer, and Williams reports several cases of this disease.

Moles and sebaceous cysts are also found upon the nipple and areola. Hermann reports a case of dermoid affecting the nipple and pushing its way inward into the gland-tissue.

THE SURGERY OF THE MALE BREAST.

The anatomy of the male breast has not received the attention which it deserves. To understand the many pathological changes to which the male breast is subjected requires a knowledge of its anatomy.

The male breast is a rudimentary conical-shaped gland which is encapsulated in a special fascia of its own, which separates it from other structures, and is small as a rule. The two glands are situated upon each side of the chest opposite to the fourth and fifth ribs. Their bases are attached to the fibrous and fatty tissue between the posterior surface of the gland and the pectoral fascia covering the pectoralis major muscle, and the apices, which are situated about four inches from the middle of the sternum, terminate in the nipple. The right nipple is not infrequently a little over four inches from this point, and is placed at a higher level. The left is opposite to the fourth rib. Deviations from the normal standard occasionally occur; thus Birket reports four cases in which there were supernumerary nipples. They were situated just below the two normal nipples. The extra nipples were smaller, but the areolæ were the ordinary size and very distinct. In one of these cases an offspring had likewise four nipples, but the rest of the progeny had only two nipples.

The gland itself is smaller than that of the female, in that it possesses diminutive acini and small ducts leading into straight ducts of very

small calibre which terminate in the nipple. In elderly people there is often a superabundance of fat deposited in front of as well as behind the gland, and also in the gland itself. The fascia previously mentioned which encloses the gland takes its origin from the sternum, and, passing toward the gland, it divides into two layers which ensheath the gland in front and behind. The anterior layer terminates in the nipple, and the ligamenta suspensoria of Sir Astley Cooper are attached to its anterior surface. The posterior layer of the divided fascia passes behind the gland and loses itself in the aponeurosis of the pectoralis major muscle. From the anterior surface of this posterior layer trabeculæ are sent into the gland between the acini and the ducts and lobules, and these fibrous septa serve to bind all the component parts of the gland into one organ. Besides these septa, which project into the gland from the anterior surface of the posterior layer of the fascia, others are sent from the posterior surface of the posterior layer to the aponeurosis of the pectoralis major muscle, and these fibres serve to form an attachment of support to the gland.

The arterial supply of the male gland is derived from the thoracica longa and from the external mammary artery from the axillary artery.

The internal mammary artery also sends four or five perforating branches to the gland. These vessels pass to the gland between the cartilages of the ribs. The mammary intercostals also send branches to the posterior part of the gland.

The veins form an anastomotic circle around the nipple and areola and return the blood. From this circle the veins radiate, some to

FIG. 439.

Case of enlarged mammary gland in the male.

accompany the thoracica longa, others the external mammary, both of which join the axillary vein. Upon the inner side of this gland the veins empty into the subclavian, forming the venæ comites of the internal mammary and intercostal arteries.

The lymphatics in the male breast are numerous. One set joins those just under the margin of the pectoralis major muscle, and lies upon a portion of the fascia which forms a part of the axillary fascia between the planes of muscles. Another set goes to the axilla and another to the sternal side of the gland, perforating the intercostal spaces to the anterior mediastinum to join the lymphatics from the convex surface of the liver. Upon the right side these lymphatics terminate in the junction of the right jugular and right subclavian veins, and upon the left side enter the thoracic duct.

The nerves of the male breast are derived from the third, fourth, and fifth dorsal, which proceed from the spinal cord and traverse the grooves upon the inner surface of the ribs until they are opposite to the gland. They then perforate the intercostal muscles and are distributed to the gland itself as well as to the skin. The third dorsal nerve accompanies the external mammary artery and supplies the nipple. The fourth dorsal nerve accompanies the external mammary artery and supplies the gland and the nipple, also the skin. The fifth dorsal nerve perforates the chest between the fifth and sixth ribs and supplies the posterior and lower segment of the gland. It inosculates with the fourth, and likewise sends filaments to the nipple, also the areola. These dorsal nerves form an inosculation with the sympathetic, so that the breast has a supply from that system as well as from the cerebro-spinal.

FIG. 440.

Case of enlarged mammary gland in a boy.

There is nothing peculiar in the examination of these parts, and there are no functional disturbances deserving of special consideration. Inflammatory affections may occur in consequence of injury, and at puberty the breasts in a young man become swollen and tender, but in a short time the tenderness and pain disappear. The breast may even suppurate, and abscesses form which require a surgical operation to relieve.

GYNÆCOMASTIA (*γυνή*, a woman, *μαζός*, a breast) is comparable to hypertrophy of the female breast, with the exception that the growth in the male is subject to limitation. The disease is rare, although in ancient times it was said to be quite common. It is said that gynæcomastia is very common in Pomerania, and that in some cases even milk is secreted. The writer has under observation at the present time four cases, in one of which the right breast is involved and has attained the size of a normal functional female gland (Fig. 439). Another, in which both breasts are

enlarged, is a case of a boy suffering from myxœdema, and the remaining two are hermaphrodites.

Mention is made by Pétrequin of a case in which the breasts were eighteen inches long, and were so large as to require their removal.

The disease may occur with or without testicular atrophy and effeminacy. The enlargement may occur at any period of life, but usually at puberty, at which time the nipple may exude a small quantity of milky fluid.

The enlargement of the male breast may be found in connection with certain congenital anomalies, as hypertrophy of a corresponding half of the body, or with pleiomazia. The disease is also associated with arrest of development in the sexual organs, and, in conclusion, with hermaphroditism.

Certain diseases which affect the body of the testicle, and which lead to atrophy, are apt to produce an enlargement of the male breast.

If orchidectomy is performed before the boy reaches puberty or late in life, the operation is not attended by hypertrophy of the breast; but if the removal of the testicle is performed during the period of the greatest sexual activity or between the ages of fifteen and thirty, hypertrophy of the mamma is likely to follow. There is every reason to believe that in ancient times the male breast secreted milk, and cases of this nature have been reported within recent years by more than a half dozen reliable authorities.

Prof. Dunglison has reported a case of lactation in the male occurring in the practice of Dr. C. W. Horner of Philadelphia. The patient was a blacksmith aged twenty-two, who in February, 1850, noticed that his left breast was gradually enlarging, and continued to increase until it had attained the size of a woman's breast during lactation. He was examined by Prof. Muller, who found the breast was full of milk.

INFANTILE DISEASES OF THE BREAST in both sexes are observed from time to time. The breast a few days after birth is often found engorged and swollen and painful. The inflammatory process may be so acute as to give rise to a typical abscess. Often a milky discharge escapes from the nipple, and an examination of the fluid reveals the presence of milk.

Guillot believes that in every child born, whether male or female, the miniature breast secretes a small quantity of milk at the time of the separation of the cord. The treatment of all such conditions is based upon the principles already pointed out in connection with the discussion of similar affections involving the breasts of adults.

ABSCESS OF THE MALE BREAST may occur in consequence of traumatism, a good example of which has been recorded by Péan. This specimen is to be seen in the Pathological Museum of the Hôpital St. Louis, Paris. The abscess was submammary, and followed repeated contusion from the use of a rapier. In the same collection is another case in which the cause of the abscess was from the bite of a horse, and the pus was also found in the submammary region. There is recorded the case of abscess of the male breast in a soldier who was struck violently by a ball on the breastplate of his uniform. The injury was followed by a deep-seated abscess.

The writer saw in Fournier's collection a specimen of pure anthrax

which developed on the skin at a point midway between the two mammæ.

In young boys the breast may inflame and suppurate at the time of puberty. The treatment of these acute inflammatory affections is based upon the principles of modern surgery—free incision, antiseptic irrigation, drainage, and healing under sterilized dressings. If the inflamed breast is seen in the early stages of the attack, hot antiseptic gauze can be applied with gentle but firm compression. Leeches may also be used, and even a blister in some cases, and in the latter stage mercurial or iodide-of-potash ointment or the oleate of mercury or atropine painted over the breast.

Tuberculosis of the male breast has been observed, according to Robinson, who collected several cases which he added to his own. He also states that in the collection he found no case under puberty.

Simple cysts of the male breast are by no means rare. They may take their origin from a lacteal duct or in consequence of a mastitis induced by gout. Morgagni reported a case in which a gouty patient's breast began to enlarge at thirty-one, and continued to grow for fourteen years, until it had attained the size of the fist. It finally ulcerated, and upon removal the tumor was cut into and one part of it contained chalky deposits.

Velpeau reported a case of a boy of fifteen years who had a cyst in the right breast the size of a child's head, and it grew in about one year without any assignable cause. In this case the cyst was tapped and an injection of tincture of iodine in water was introduced, and the sides of the cyst-wall became agglutinated by inflammatory adhesions.

Cysts may be congenital, in which case they are typical dermoid cysts. The writer saw a beautiful specimen of cyst of the male breast presented to the Hunterian Museum by Mr. A. Pearce Gould. The cyst was double, and the cavities were separated from each other by a thin fibrous partition, and the interior of each contained a blood-clot, the larger one being an inch in diameter.

Sebaceous cysts may occur in the male breast. In one specimen which the writer examined the cyst was very large, and it had developed in a patient who was twenty-nine years old, while the tumor showed itself for the first time when the young man was fifteen years old.

Papilloma of the skin over the mammary region may occur. The writer saw a specimen of this disease in which the growth was situated upon the left side of the nipple.

Adenoma of the male breast occasionally occurs. Prof. Humphrey has preserved a specimen in his collection at Cambridge, in which the nipple was greatly retracted. The tumor was due to an increase of the connective and glandular tissue.

Williams states that in 280 adenomata of the breast only in 1 case did it occur in the male.

Dr. Erdmann has recently operated upon an adeno-fibroma of the right male breast. The patient was sixty-one years of age, a weaver by occupation, and the tumor had existed for a number of years. The tumor was hard and the size of an egg. In opening the axilla the glands were found indurated and were removed.

Sarcoma of the male breast has been observed. Williams collected

68 cases of sarcoma of the breast, in which 2 involved the male breast. Müller and Arnott have each reported a case of sarcoma of the male breast in which operations were performed.

FIBROMA of the male breast is exceedingly rare. Williams was able to find only 2 cases of this variety of tumor, although adeno-fibroma has been observed by several surgeons.

CHONDROMA is also a rare affection of the male breast. In the few cases in which the disease has occurred the growth seems to have taken its origin from the ribs or costal cartilages, and secondarily involved the breast-gland.

LIPOMA has been observed by Sir James Paget, Queirel, and Bowlby. There is nothing characteristic in this disease, and it is usually associated with multiple lipomata.

ANGIOMA has been observed three times by Williams. In the first case the tumor was congenital and was about three and a half inches in diameter; in the second case the angioma developed in connection with a congenital nævus situated over the region of the liver; and in the third case the angioma developed in connection with a cyst which contained blood. There are a few other isolated cases occurring in the literature of the subject, but none which present any new features. In the Pathological Museum of Guy's Hospital there is preserved an angioma of the male breast which occupies the site of the nipple.

Scirrhus of the male breast occurred in the practice of the late Dr. James R. Wood, who had notes of six cases. The writer operated upon one case some years ago, and, while the microscopical examination revealed the presence of scirrhus, the subsequent history of the case is unknown.

Prof. Humphrey operated on one case of scirrhus of the male breast. The tumor is preserved in the Pathological Museum at Cambridge.

Wagstaffe collected 61 cases of cancer of the male breast. The disease occurs, according to Williams, in about the proportion of 1 in the male to every 100 in the female.

Dr. Erdmann has recently removed an adeno-carcinoma of the left breast in a patient who was sixty years of age. The tumor had existed for five years. It was ulcerating, and had a discharging area the size of a silver quarter of a dollar. The tumor was hard and about the size of a child's fist. The glands in the axilla were large, and were also removed.

EPITHELIOMA of the skin covering the gland in the male has been observed. Of two cases which the writer saw, in one the ulcer was situated upon the mammary integument a short distance from the nipple, toward the axillary line. In another case the ulcer was situated in the same locality, and had sloughed so that there was left an excavation with all the signs of progressive malignancy.

RODENT ULCER of the male breast has been reported by Robinson and operated upon by Anderson. The nipple began to exude a serous bloody discharge three years previous to operation. At the time of operation the nipple was entirely destroyed, and an irregular ulcer about the size of a silver quarter of a dollar, with raised edges, was present. There was no induration around the patch and no axillary involvement. A microscopical examination revealed the presence of a growth "with

down-growing processes from the rete into the connective-tissue spaces." There was no round-cell infiltration in the connective tissue, and no cornification of the epithelial pearl-globules, as in true epithelioma, which distinguishes it from rodent ulcer.

The **treatment** of the tumors and cysts of the male breast can be considered collectively, since there is nothing special in the management of any one of the several varieties. Free excision by elliptical incisions is indicated, and the entire growth or the cyst should be removed and the wound dressed aseptically.

In case the neoplasm is malignant, the axillary glands must be carefully examined and, if enlarged, removed. The same rules are to be observed in epithelioma of the male breast as guide the surgeon in carcinoma of the female breast.

THE USE OF THE RÖNTGEN OR *X* RAYS IN SURGERY.

By W. W. KEEN, M. D., LL.D.

In December, 1895, Prof. W. C. Röntgen of Wurtzburg, Bavaria, announced that he had been able to take pictures of the bones of living persons by means of certain rays emanating from a Crookes vacuum tube. This was an application and extension of the prior researches of Hertz and Lenard, and instantly created the greatest interest in the profession, as its possible surgical value was immediately recognized and applied.

The name which Prof. Röntgen gave to the rays by which he produced his pictures, "*x*" rays, was for the purpose of indicating their unknown character by an algebraical formula. Even at the present time, in spite of the investigations of a large number of observers, and among them some very prominent physicists, the nature of the *x* rays, whether longitudinal vibrations or not, is as yet quite unascertained. They are not subject to refraction or reflection, as all other rays are. It seems not improbable that in consequence of this discovery our views of light, heat, electricity, and vibratory manifestations in general may have to undergo revision and possibly serious alteration. Even our views upon so apparently a well-settled matter as the nature of light may have to be revised.

The method of using these rays is shown in Fig. 441. In the background is seen a Ruhmkorff coil, which is excited by means of a storage-battery of sufficient power. In front of the coil, held in a wooden holder, is the bulb of a Crookes tube. The two wires coming directly from the poles of the Ruhmkorff coil and connected with the anode and the cathode of the Crookes tube are well shown. Underneath the tube is seen the hand to be skiagraphed, and under the hand, in a closed wooden plate-holder, is the quick photograph plate. The Crookes tubes vary greatly in value. They should be made of glass without lead and of high vacuum. Newton & Co. of London have made what they name a "focus tube,"[1] exhausted to $\frac{1}{147}$ of a millionth of an atmosphere, which is said to give the best results. The experience of Mr. Shallenberger with one of these tubes, however, has not been very satisfactory.

The peculiar property of the *x* rays is that they will penetrate what we commonly regard as opaque substances. This ought not really to astonish us when we remember that glass, which is absolutely transparent to light rays, but is to a large extent opaque to heat rays (though both of

[1] *Brit. Med. Journ.*, Mch. 21, 1896, p. 748.

these rays differ only in their rate of vibration), should not be taken as our mental standard. The familiar ground glass and milk glass or other opaque shades of our gas and electric lights are permeable to light, though we cannot see through them. Oiled paper and thin layers of minerals and metal are translucent, as we know perfectly well, when cut in slices of sufficient thickness for microscopical purpose. That the *x*

FIG. 441.

rays can penetrate substances which are opaque to ordinary light, therefore, should not be so much of a surprise. They can penetrate through several inches of wood, through aluminum, surgical dressings, clothing, shoes, etc. with perfect ease, so that a fracture which has already been dressed with wooden splints, bandages, cotton-padding, etc. can be readily skiagraphed. Plaster of Paris, if used for the splints, entirely obstructs the rays.

The time required for taking such a skiagraph at first was very long, requiring not uncommonly an hour to an hour and a half. Recently, however, with improved plates, but especially with improved apparatus for production of the rays, the time has been shortened until the thicker parts of the body—*e. g.* the knee or shoulder—can be skiagraphed in a quarter to half an hour, and the thinner parts, such as the hand or the foot, in a very few minutes or even a few seconds. Macintyre of Glasgow[1] in fact announces that he has succeeded in taking the bones of the hand "with one flash in the tube from a single interruption of an eleven-inch spark coil," or a very minute part of a second. Doubtless the skiagraph of a few months hence, when this article may be read in print, will be practically instantaneous. In fact, it must be remembered that

[1] *Lancet*, Apr. 25, 1896, 1161.

the use of this method is changing so rapidly and being perfected so constantly that many of the views expressed at the present time (May, 1896) may be quite obsolete when they are read.

The rationale of the method is as follows: When, for example, a hand is interposed between the source of the *x* rays and a sensitive photographic plate, all the tissues of the hand, it must be remembered, offer an obstacle to the passage of the rays. It is generally imagined that only the bones are skiagraphed, and that the soft parts are perfectly translucent to the rays. As a matter of fact, *all* tissues cast skiagraph shadows by preventing the rays from reaching the plate. But while some, such as the soft parts, are quickly penetrated by the *x* rays, so that the rays act chemically upon the plate and thus efface the shadow, others—*e. g.* the bones—offer more of an obstacle to the passage of the rays, and their shadows are therefore more pronounced and distinct.

There are two methods by which skiagraphs may be taken:

I. That in which the plate is exposed to the rays sufficiently long to get a skiagraph of the bones, and allow practically only their shadows to be seen to any extent, the shadows of the soft parts being to a large extent effaced. This is the usual method so far used.

II. A second method, however, which I think has not been tried, but which I would like to suggest, would be by placing half a dozen paper films in the plate-holder.[1] Glass plates will not do, for the reason that the first glass plate would cut off the rays to the underlying ones. If the films, however, are of paper, the *x* rays will act upon all the half dozen films and develop shadows on all at the same time. If, now, one of the films is withdrawn, say in five to fifteen seconds, another one at the end of a minute, a third at the end of two minutes, a fourth in five minutes, and a fifth and sixth at ten or fifteen minutes (great care being taken not to disturb the various sheets or the images would be blurred), we then get a series of pictures of the same object exposed for different lengths of time. This would enable us, I think, to obtain pictures of the soft parts of the body much more perfectly than has been done hitherto, and it is not at all impossible that the viscera, such as the stomach, kidneys, lungs, heart, etc., may be skiagraphed successfully. The trouble with our present pictures is largely that they have been exposed long enough to show the bones, by which time the rays have so penetrated the soft parts that but very faint shadows of any of the soft parts are left. Sesamoid bones show very distinctly. In Plates XX., XXI., and XXII. the sesamoid bones of the thumb come out clearly.

If the second of these methods is employed, the first film withdrawn, which will have been exposed to the rays for only a short time, will have a distinct shadow cast by even the most easily permeable of the soft parts; in the second and succeeding films the soft parts will have been penetrated for a longer and longer time successively in each plate, and will leave less and less of a shadow, while the denser tissues, and especially the bones, will come out more and more distinctly. Even in plates taken by the first method the differing degrees of permeability of bone, muscle, skin, and the subcutaneous fat is very well shown in Plate XVIII. If this figure be carefully observed, there will be seen a very

[1] While reading the proof I see that Stover (*N. Y. Med. Record*, May 16, 1896, 717) has suggested the same method.

faint shadow corresponding to the skin and subcutaneous tissue; beneath this a little deeper shadow shows the supinator longus and other muscles going from the humerus down on the forearm, and lines in a different direction converging at the olecranon show the belly and tendon of the triceps. The "graduated method," as I would call it, I am convinced, will do a great deal in this direction. So, too, in Plate XIX., the varying thicknesses of the soft parts near the toes and the heel show the same fact very well. If the plates are exposed to the rays long enough, the thinner parts of the bones disappear, and in time every vestige of the shadow produced by the bones would disappear, since the rays would have permeated them sufficiently to efface all record of their presence on the sensitive plate.

Where the soft parts, or still more, where two bones overlap, the shadow is much denser than that of a single bone, so that each can be perfectly seen. Thus Plate XIX. shows the heretofore unsuspected overlapping of the metatarsal bones in club-foot; and in Plate XVIII., which was taken from the posterior surface of the elbow, the coronoid process of the ulna can be seen through the olecranon, and if it had been fractured the fracture would have been recognized. In Plate XIX. the medullary cavity in the bones shows distinctly. In the skull the cavity of the orbit and the maxillary antrum show very well. Disease of the roots of the teeth which enlarged the roots or eroded them would easily be recognized.

One great advantage of the more rapid taking of the pictures, and especially if instantaneous pictures can be taken, will be that we can skiagraph those parts of the body which cannot be kept motionless for any long period, as, for instance, the chest, the bones of which are constantly moving in respiration, and so blur their outlines to some extent. If we can succeed hereafter in skiagraphing the soft parts instantaneously, we may be able to obtain pictures of the heart in systole and diastole and in the interval between the two. We shall then be able to get pictures of the liver, stomach, and intestines, organs which are always in motion either by the respiratory act or by their own independent motion. The daily papers announce that this has been done in Berlin, but the method is not described.

The illustrations for the present article have been kindly furnished by Mr. Herbert B. Shallenberger of Rochester, Pa., Prof. Arthur W. Goodspeed and Dr. W. C. Cattell of the University of Pennsylvania, and permission to use one of them has also been given by Prof. DeForest Willard of the University of Pennsylvania. Some are taken from an article by Prof. W. F. Magie of Princeton, Prof. Edward P. Davis of the Jefferson Medical College, and myself, and published in the *American Journal of the Medical Sciences* for March, 1896.

In addition, however, to obtaining skiagraphs or shadow pictures of the internal parts through the flesh, it is possible to employ a second method—namely, that of direct observation. Prof. W. F. Magie of Princeton[1] and Prof. Salvioni of Perugia about the same time hit upon precisely an identical method of doing this. Taking advantage of the fact that certain salts, especially the platino-bari-cyanide and the tungstate of calcium, fluoresce very remarkably when illuminated by the *x*

[1] *Medical News*, Feb. 15, 1896.

rays, they constructed an instrument for the direct observation of the bones. It consists of a hollow cylinder a few inches long, one end of which is applied to the eye, the other end, instead of having a lens, being covered by a piece of paper smeared with the phosphorescent substance. When a hand is interposed between the cylinder and the Crookes tube, the rays penetrate the soft parts, but the bones, being relatively opaque, are seen as dark substances. A lead pencil is seen as a narrow bar, which represents the lead, the wood being perfectly translucent. If this method can be perfected—and it is being steadily improved—it will furnish the quickest and most easily used method of studying such parts of the body as can be seen by it. Its only disadvantage is that it leaves no permanent record as does the skiagraph, to which appeal can be made, for instance, in medico-legal cases.

The nomenclature of this subject is a matter of some importance. The popular use of the terms "shadowgraph," "radiograph," "rayograph," etc. is greatly to be deplored. Such philological abominations, hybrids of Greek and English, are of course wholly inadmissible. The word shadowgraph can only plead its evident meaning as a possible justification. The word skiagraph, proposed originally by Dr. Cattell in the *Medical News* for February 15, 1896, is far the best, being derived from the Greek word *σκια*, meaning shadow. Similarly, the instrument of Magie and Salvioni would be best called skiascope. Prof. Salvioni calls it the cryptoscope; a somewhat similar instrument devised by Mr. Edison is called the fluoroscope.

Let us turn now from the methods of using the Röntgen rays to their practical application—first, as to what parts of the normal body can be skiagraphed, and then as to the clinical application of the method to the diagnosis of disease and injury.

As already indicated, all the soft parts of the body cast shadows which can be photographed if exposed for a relatively short time, but on a longer exposure their shadows lessen in intensity, and finally disappear. Of the soft parts, the skin, subcutaneous fat, and cartilage are very permeable. Plate XIX. of a club-foot in a child of six shows beautifully a long gap in the tarsus, where the bones are only cartilaginous, and shows equally well the epiphyseal cartilages by the gap between the diaphyses and epiphyses of the tibia, the fibula, and the metatarsal bones and phalanges. Reid of Dundee states that the kidney out of the body shows the difference between the cortical portion, which is transparent, and the medullary part, which is less so. On the contrary, the gray cortex in the brain is less transparent than the white substance. As has already been pointed out, the muscular tissues cast distinct shadows on moderate exposure. Plate XX. shows very well the slight shadows of the soft parts. In Plate XXIII., a remarkable skiagraph of the upper trunk, we see in the median line the dark shadow of the vertebræ and sternum combined in a rather confused outline from the double shadow. The ribs and the cervical vertebræ show with startling distinctness. The thinner parts of the scapulæ are faintly seen, but the thicker parts are very distinct. The shoulders, especially that on the left of the picture, are so distinct that any disease which would modify the outlines of the bones—bony ankylosis,

erosion by tubercular joint disease, abscess in the bone, fracture or dislocation—could be determined almost at a glance.

It is very possible that we may hereafter be able, especially by the graduated method, to skiagraph the viscera, and if so to determine the presence of calculi and of foreign bodies, such as a gold artificial denture, which would be opaque to the rays. We may even be able from day to day to trace its progress and determine the fact that it has or has not been arrested at the ileo-cæcal valve, and therefore whether an operation should be done for its removal. Calculi in the kidneys, by their contrast to the more permeable soft parts of the kidney, may also be determined.

I think it not unlikely that we shall be able to determine the existence, size, and other facts in relation to abdominal tumors, even though they may be soft and quickly permeable. The body of a fœtus is very permeable: even the bones, which have but little of the lime salts deposited in them, present much less of an obstacle to the passage of the rays, and therefore cast less dense shadows than the adult bones. I think it not improbable, however, that very soon we may be able during pregnancy to determine the position of the fœtus and any abnormalities should they exist. One great barrier to such skiagraphs, however, is the fact that the bones of the mother's pelvis will prevent the access of the rays to the fœtus. Rowland[1] made a partially successful skiagraph of a pregnant cat, which showed faint traces of the uterine cornua and their contents. I think it likely, however, that shortly this difficulty may be overcome, as the denser shadows where the bones of the mother's pelvis and those of the fœtus coincide, and the lighter shadows of the fœtal bones where not coincident with those of the maternal bones, may enable us to determine the position of the fœtal head. For the same reason—*i. e.* the interference of the pelvic bones—tumors of the bladder will be difficult to skiagraph, but it is not an impossibility that this may be overcome. Calculi in the bladder could readily be determined, for they cast extremely well-defined shadows out of the body,[2] but the obstacle before mentioned, of the bones of the pelvis, may present a serious difficulty, and possibly even an insurmountable obstacle. Thus far, all attempts to skiagraph the brain have been unavailing, and I fear may always prove to be such. With Profs. Magie and Davis[3] I attempted to skiagraph the skull of a girl whom I had trephined some years ago, hoping that, as there was a large opening in the skull, I might be able to observe the lightening of the shadow opposite the opening, but the plate showed absolutely nothing whatever. Should this difficulty ever be overcome, it is possible that we may be able to do something with it in cerebral surgery, but the ordinary tumors, tubercular and sarcomatous, are as translucent to the rays as the brain itself, so that it is doubtful if they can be differentiated from the cerebral tissue.

Reid[4] states that a cancerous liver shows no difference between the diseased and normal parts. I think it not unlikely that the thoracic viscera may be skiagraphed with some approach to clearness before long. Thus far, however, the attempts have been only partially successful, partly

[1] *Brit. Med. Journ.*, March 7, 1896.
[2] Leon, *Ibid.*, April 4, 1896.
[3] *Amer. Journ. of Med. Sci.*, March, 1896.
[4] *Brit. Med. Journ.*, Feb. 15, 1896.

PLATE XVIII.

Elbow, taken from Behind. Observe Shadows of Skin and Subcutaneous Fat, Muscles, and Overlapping Bones.

[Skiagraphed and loaned by MR. HERBERT B. SHALLENBERGER, Rochester, Pa. Exposure, 15 minutes.]

PLATE XIX.

Club-foot, Child aged Six; patient of Dr. De Forest Willard,
by whose permission the illustration is used.

[Skiagraphed by Prof. Arthur W. Goodspeed. Copyright 1896, by William Beverlan Harrison.]

PLATE XX.

Skiagraph of the Hand of a Young Lady, aged Twenty-six, showing a Needle Imbedded in the Muscles for Twenty Years.

[Skiagraphed and loaned by MR. HERBERT B. SHALLENBERGER, Rochester, Pa. Exposure, 5 minutes.]

PLATE XXI.

An old Dislocation of the Wrist, with Fracture and Disappearance of the Styloid Process of the Ulna.

Note the darker shadows of the pisiform bone and the unciform process.

[Skiagraphed and loaned by MR. HERBERT B. SHALLENBERGER, Rochester, Pa. Exposure, 40 minutes.]

PLATE XXII.

Hand and Wrist of an Uninjected Cadaver, into the Palmar Aspect of which a Needle and Two Buckshot were Thrust.

[W. F. Magie, E. P. Davis and W. W. Keen, in *The American Journal of the Medical Sciences*, March, 1896.]

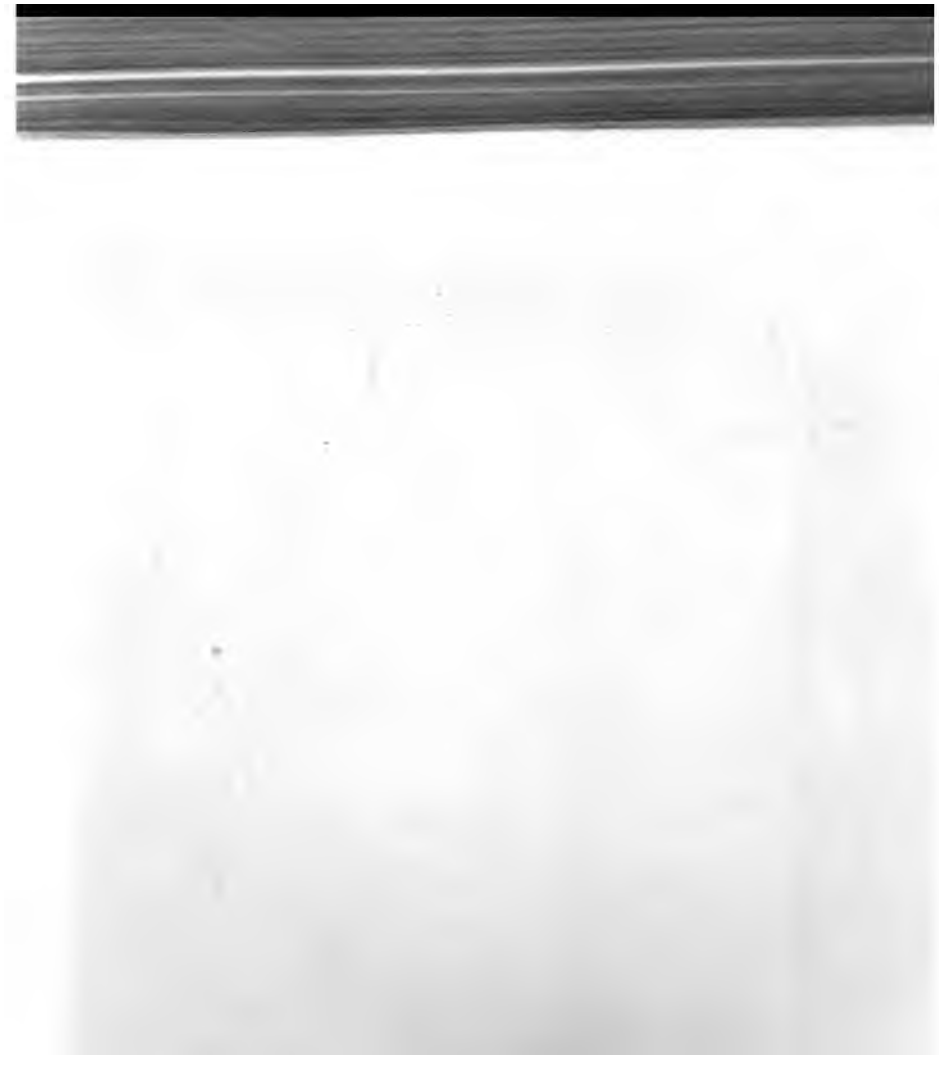


PLATE XXIII.

Skiagraph of Thorax and Arms.

Observe especially the Cervical Intervertebral Substances, Ribs, Clavicles and Shoulder-joints.

[Skiagraphed by PROF. A. W. GOODSPEED, and kindly loaned by DR. H. W. CATTELL.
From the *International Medical Journal*. Equal definition in one minute.]

due, doubtless, to the encasing bony parts, scapula, sternum, ribs, and vertebræ, partly to the fact that both heart and lungs are in such constant motion, and partly to the thickness of this portion of the body, which makes it very difficult to skiagraph, especially in a short time. Plate XXIII., however, shows the possibilities of the future (*vide supra*). If a coin or other opaque body were in a bronchus outside the limits of the shadows of the sternum and vertebræ, it would certainly easily be seen in such a good picture.

The most important and useful application of the *x* rays, thus far, has been in the diagnosis both of diseases and injuries of the bones. The difficulties, even under ether, of determining the exact lesion in many such cases, especially when there is great swelling, every surgeon knows, but the Röntgen rays are almost oblivious of swelling, and the bones can be skiagraphed with equal accuracy whether the elbow or ankle be swollen or not. If we compare Plate XX., a normal wrist, with Plate XXI., a case of old dislocation, it will be instantly observed that in the latter the styloid process has been broken off and probably absorbed. At all events, it has disappeared in some way. A considerable number of cases have already been published in which the condition of the bone after old fractures has been positively determined.

Gray[1] in a case of doubtful injury at the elbow with great swelling was able to determine the fact that there was dislocation of both bones of the forearm outward—a very rare form of dislocation. Moreover, after a fracture has been dressed or a dislocation presumably reduced it will be very possible, even through wooden splints and dressings, to determine whether the bones are in their proper place.

I have no doubt that advantage will be taken of this in cases of unfortunate results after fracture or of a mistaken diagnosis between fracture and dislocation in medico-legal cases, to the disadvantage of the surgeon. In fact, this has already been done in two cases that I have seen alluded to in the newspapers. At present it will be impossible, however, justly to draw conclusions which may be adverse to the surgeon, because there have not been any skiagraphs made in cases of fracture during the normal process of repair, and therefore it will be impossible accurately to distinguish between the normal and the abnormal processes until we obtain first the former as a standard. It may become, however, a very serious question in the future whether it will not be essential that cases which may involve litigation (and who knows what case will and will not?) should be skiagraphed to show positively and by unquestionable permanent records what the initial lesion was, and that the proper reduction of the fracture or dislocation was secured, as well as possibly, by one or more later skiagraphs, to demonstrate the progress of the case. It will, however, be a great hardship on the surgeon, especially in the charitable work of our hospitals and dispensaries, if it shall prove necessary to take so much time and go to so much expense as this when the surgeon receives no remuneration for his time and labor.

In obscure diseases of bone the process has already proved of great advantage. Thus Abrahams,[2] in a case of injury from a cricket-ball with a bent finger, was able to determine that a small bridge of bone existed between the last two phalanges, which was broken up with little force

[1] *Brit. Med. Journ.*, March 7, 1896.

[2] *Ibid.*, Feb. 22, 1896.

and the normal use of the hand restored. In another case, of ankylosis of the knee mentioned to me by Dr. Willard, he desisted from breaking it up, since the skiagraph showed such marked irregularity of the surface of the bone as to make it probable that a serious tubercular inflammation might result if it were done. The excellent case of Mosetig,[1] in which there was a supernumerary bone in the last phalanx of the great toe, is a case in point. It was impossible by manipulation to tell which of the two bones was the normal one. The skiagraph instantly showed the facts and indicated the proper treatment.

Tumors of bone—especially, for instance, central sarcomata—which produce enlargement of the bone itself can be readily skiagraphed. Cartilaginous tumors or periosteal sarcomata would be skiagraphed with difficulty, unless possibly the graduated method would show them. Diseases of the joints are also easily skiagraphed in case there is any invasion of the bony tissue. Thus in the *American Journal of the Medical Sciences*, March, 1896, Plate II. shows a very distinct light space in the elbow-joint corresponding without doubt to a tubercular abscess. Cases of tubercular abscess in the head of the tibia, diagnosticated by this method, are mentioned in the *British Medical Journal*, April 25, 1896, p. 1059, and May 16, p. 1225. Deposits of uric acid in gouty joints will probably also be seen, and I think it likely that calcified arteries will show well in skiagraphs.

The discovery of foreign bodies is one of the most important uses of the Röntgen rays. I have already alluded to the difficulty experienced in determining the presence of calculi in the bladder and in the kidney. In the latter the difficulties probably will be soon overcome; in the former it is possible that hereafter we may overcome them. Gall-stones are quite permeable to the rays, and therefore their presence cannot be determined either in the gall-bladder or in the ducts, but I think it probable that this difficulty may be overcome by the graduated method. I have already alluded also to foreign bodies that have been swallowed and may be discovered in the stomach or intestines. Foreign bodies permeable to the rays, such as wooden toys (probably also rubber artificial dentures, though I have not tested their permeability), will be discovered with difficulty, but metallic bodies, such as needles, bullets or shot, and glass, which is certainly quite opaque to the rays, have been now located in a large number of cases. Plate XXII. shows a needle and two buckshot inserted in the tissues of a dead hand. It will be observed that the shot, by reason of the fact that their shadows are much denser than those of the bones, are seen through the bones. A ball imbedded in a bone therefore would be readily detected.

Plate XX. is an admirable illustration of a needle imbedded in the hand of a young lady of twenty-six, who when she was only four or five years of age in dressing a doll broke off a part of the needle, and it has remained in her hand ever since, a perfectly innocuous body. It will be observed especially that the needle has not been corroded sufficiently to destroy even the thin rim of steel forming its eye. This very skiagraph also suggests an important lesson. When such a foreign body is found the temptation is very strong to remove it. Prof. von Bergmann has already raised his voice in a protest against the indiscriminate

[1] *Brit. Med. Journ.*, Feb. 8, 1896.

removal of foreign bodies of this character which are doing no harm, but have been discovered by the Röntgen rays, and I certainly would reinforce his warning. To attempt to remove the portion of the needle which is shown in Plate XX., as it is doing no harm whatever, and has been resting quietly for over twenty years in its muscular bed, would be the height of injudicious surgery. The mechanical injury done to the muscles and the vessels, and possibly the nerves, with possible interference with the usefulness of the hand, to say nothing of the unsightly scar in a young lady's hand, would be real evils, while the presence of the needle is none.

The difficulties of locating needles, shot, and glass without this method is some cases are very great indeed, as every surgeon knows. The number of cases already reported in which fruitless attempts have been made to remove them, followed by a successful attempt immediately after they have been skiagraphed, shows how valuable the method will be in suitable cases. A few attempts have been made by Rowland and Waggett to see whether foreign bodies in the windpipe could be discovered by placing a coin or other foreign body on the outside of the neck and skiagraphing it. The attempts thus far have been only partially successful, but they undoubtedly show that the method will soon reach a very practicable stage. Tin toys, jackstones, nails, pins, and needles may thus be discovered, but of course beans, peas, wooden toys, and other such foreign bodies that are easily permeable to the rays will, at least for some time, elude us. While reading the proof of this article I have seen an excellent skiagraph of an intubation-tube which had slipped into the trachea. It was skiagraphed and removed by tracheotomy by Dr. J. Mount Bleyer. It is to be expected, as already indicated, that we will be able to determine absolutely the presence of foreign bodies opaque to the rays in the bronchi themselves.

It is very greatly to be regretted that the new rays have, apparently, no deleterious influence upon the growth of bacteria. Profs. Magie, Davis, and myself experimented with a number of varieties of pathological bacteria, and found that the full light of the *x* rays for over an hour was not in the least detrimental to them. In fact, if there was any change, the cultures made afterward seemed to be more luxuriant than usual. A number of other observers have confirmed this observation.

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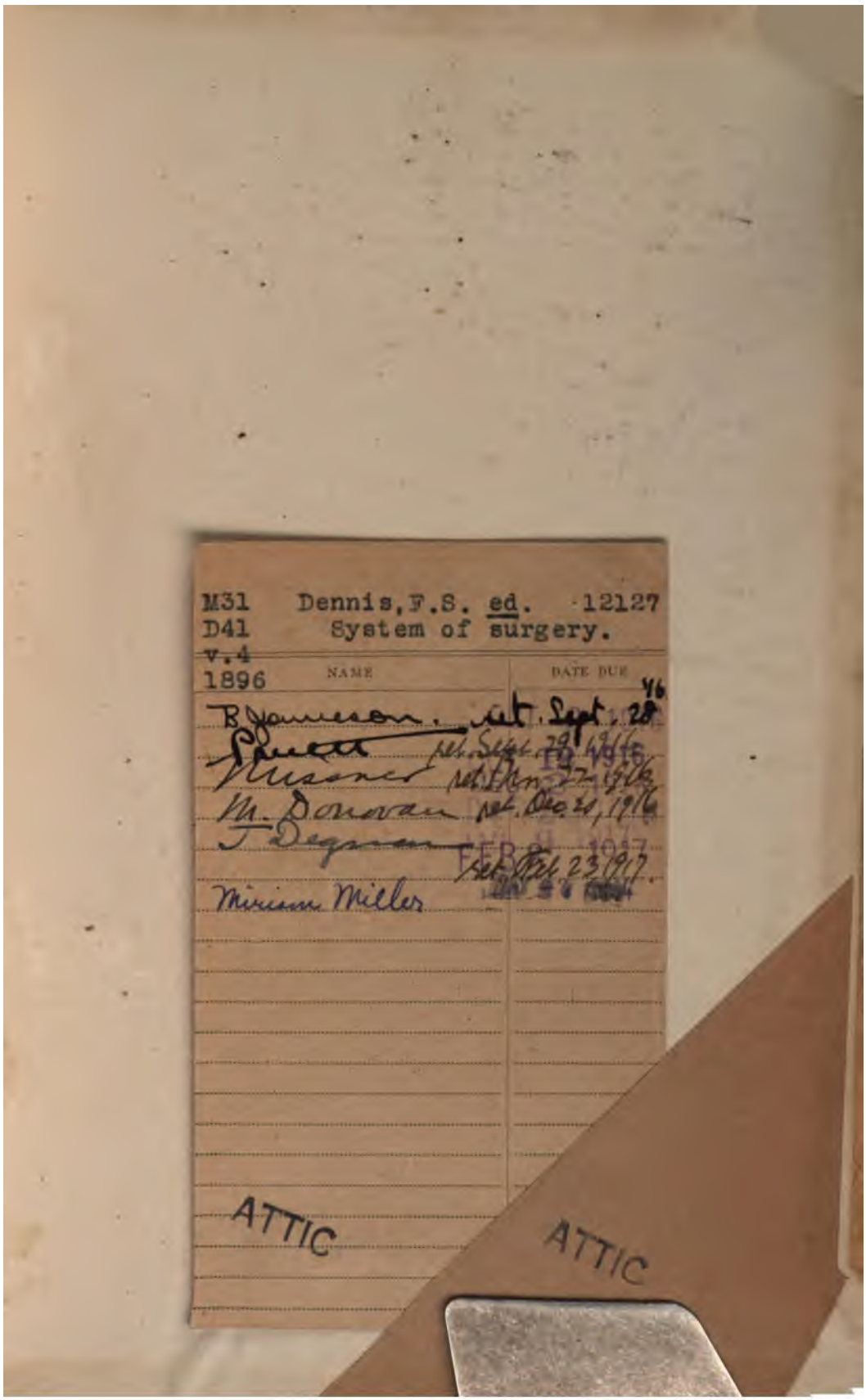
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